Artisan Technology Group

Artisan Technology Group is your source for quality new and certified-used/pre-owned equipment

- FAST SHIPPING AND DELIVERY
- TENS OF THOUSANDS OF IN-STOCK ITEMS
- EQUIPMENT DEMOS
- HUNDREDS OF MANUFACTURERS SUPPORTED
- LEASING/MONTHLY RENTALS
- ITAR CERTIFIED SECURE ASSET SOLUTIONS

SERVICE CENTER REPAIRS
Experienced engineers and technicians on staff at our full-service, in-house repair center

WE BUY USED EQUIPMENT
Sell your excess, underutilized, and idle used equipment
We also offer credit for buy-backs and trade-ins
www.artisantg.com/WeBuyEquipment ↗

InstraView™ **REMOTE INSPECTION**
Remotely inspect equipment before purchasing with our interactive website at ***www.instraview.com*** ↗

LOOKING FOR MORE INFORMATION?
Visit us on the web at ***www.artisantg.com*** ↗ for more information on price quotations, drivers, technical specifications, manuals, and documentation

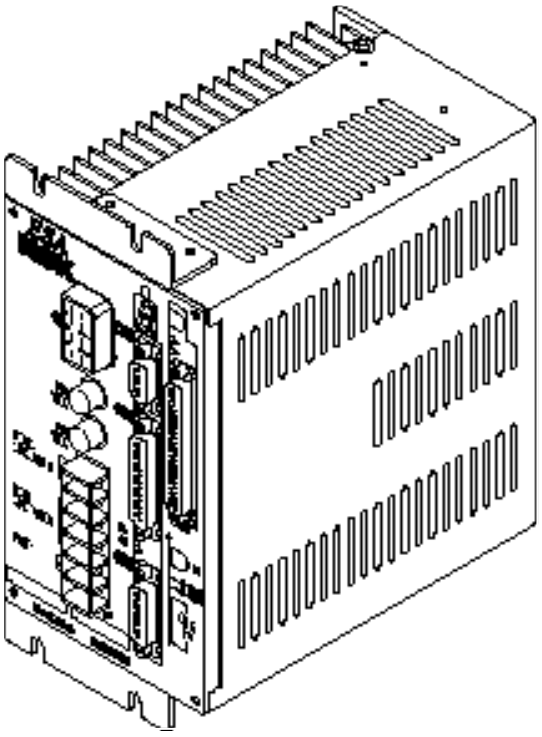
Contact us: (888) 88-SOURCE | sales@artisantg.com | www.artisantg.com

NSK

MEGATORQUE® MOTOR SYSTEM

User's Manual

(ESA25 Driver Unit System)



M-E099SA0C2-062

NSK Ltd.

Document Number: C20062-06

EC-T

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Limited Warranty

NSK Ltd. warrants its products to be free from defects in material and/or workmanship which NSK Ltd. is notified of in writing within, which comes first, one (1) year of shipment or 2400 total operation hours. NSK Ltd., at its option, and with transportation charges prepaid by the claimant, will repair or replace any product which has been proved to the satisfaction of NSK Ltd. to have a defect in material and/or workmanship.

This warranty is the sole and exclusive remedy available, and under no circumstances shall NSK Ltd. be liable for any consequential damages, loss of profits and/or personal injury as a result of claim arising under this limited warranty. NSK Ltd. makes no other warranty express or implied, and disclaims any warranties for fitness for a particular purpose or merchantability.

Copyright 1997-2001 by NSK Ltd., Tokyo, Japan

All rights reserved.

No part of this publication may be reproduced in any form or by any means without permission in writing from NSK Ltd.

NSK Ltd. reserves the right to make changes to any products herein to improve reliability, function or design without prior notice and without any obligation.

NSK Ltd. does not assume any liability arising out of the application or use of any product described herein; neither does it convey any licence under its present patent nor the rights of others.

Patents issued and patents pending.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

In order to use the Megatorque Motor System properly, observe the following notes.

1. Matters to be attended to use the Driver Unit of the Megatorque Motor System

1 Temperature

- Keep the ambient temperature of the Driver Unit within 0 to 50°C. You cannot put the Driver Unit in an atmosphere over 50°C. Keep a clearance of 100 mm in upper and lower side of the Driver Unit when it is installed in the enclosure. If heat is build up on upper side of the Driver Unit, provide the ventilation openings on the top of it or equip an air cool unit to take the heat out of the Driver Unit.
  (Measures against contamination are required for the ventilation openings.)

2 Protection against contamination and water

- Put the Driver Unit in an enclosure of which protection code is IP54 or better. Protect the Driver Unit from oil-mist, cutting oil, metal chips and paint fume etc. Otherwise it may result in failure of electric circuits of the Driver Unit.
  (IP code is in IEC standard. This is to specify the protection level of enclosures from solid contamination and water.)

3 Wiring / Ground

- Refer to User's Manual for proper wiring.
- Take appropriate measures not to contaminate the Driver Unit when wiring or installing it.

4 Storing

- Store the Driver Unit in a place at where it is not exposed to rain, water and harmful gas or liquid.
- Store the Driver Unit in a place at where it is not exposed to direct sun light. Keep ambient temperature and humid as specified.

2. Matters to be attended to use the Motor of the Megatorque Motor System

1 Dustproof and Waterproof of the Motor

- Make sure that how your Motor is graded for dust-proof and/or waterproof. You cannot use the Megatorque Motor when chemicals or paint fumes exists.
  - ◊ Standard Megatorque Motor (RS, AS, BS, JS, SS and YS Series)

    The Motor is not made for dust-proof or waterproof. You cannot use the Motor in humid or oily atmosphere (IP20, IP30 or IP40 equivalent.)
  - ◊ Simple waterproof Motor (RW series)

    The Motor is not treated for complete waterproofing. Confirm what part is not waterproof with the catalog, then take appropriate measures to these parts against water if necessary. To use the Motor for a long time, check its failure in insulation through the puncture test which shall be conducted approximately once in every half of a year. Do not use the Motor without taking measures against water and oil.
  - ◊ Waterproof Motor (RZ series: IP65 equivalent)

    Use this Motor type when splash water or oil on it. When you use the Motor in IP 66 or equivalent condition, provide air purge. The user shall provide measures against dust. Check the Motor for its deterioration by the insulation test which shall be conducted approximately once in every half a year for long term use.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

2 Use condition

- The allowable moment load and axial load differ with Motor size. Reconfirm that the using conditions are in the specified limits of the Motor.
- An excessive offset load will cause permanent deflection of the rotor and the bearing abnormality. Never apply shocks to the Motor when installing it. Be sure not to give excessive shocks to the Motor caused by external interference when operating it.
- Flatness of the Motor mounting surface shall be 0.02 mm or less.

3 Periodical check

- Puncture of the Motor and cable shorting or snapping may occur depending on using condition and environment. If the Motor is left in such conditions, it cannot exhibit its capability 100 % and will lead to the trouble of the Driver Unit. We recommend to conduct the periodical check in order to detect the problem.

3. Before concluding that the system is faulty, check the matters again.

1 Alarm arises

- Did you take proper action to the alarm? Check the action described in the manual again.

2 Power does not turn on. Indication lamp does not turn on.

- Check voltage of main and control power by a tester if the voltage is in the range of specification described in the User's manual.

3 The Motor does not function.

- Is rotation of the Motor smooth when it is turned manually with power off? Any stickiness in motion? Does the rotation axis have any axial play?
  (Never disassemble the Motor.)
- Is the control Input/Output functioning properly?
  → Monitor status of SVON, RUN and IPOS signals by I/O command through handy terminal.
  → Check if the voltage of input signal and 24 V power source are stable using an oscilloscope etc.

4 Uncontrollable Driver Unit

- Compare the current setting of parameters with the original setting at the installation. Does the PA data (unique to individual Motor) change?

5 The Motor vibrates. Positioning is inaccurate. Alarm of software thermal arises frequently.

- Are servo parameters VG, VI, PG, FP and NP adjusted?
- Do you fasten the fixing bolts of load and the Motor mounting securely? Check and fasten them tightly if necessary.
- Connect FG terminal of the Driver Unit to one point grounding. Ground the Motor and the Driver Unit respectively. (Refer to User's Manual for wiring.)
- Is any external interference with rotation in Servo lock state? (It leads to the Motor overheat if external force is applied to it in servo lock state.)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

6 Breaker trip occurs frequently.

- When the system recovers by replacing fuses or remaking the power, take the following action.
  - ◊ We recommend to install a delay type breaker for a measure against breaker trip.

4. Others

- Combination of the Motor and the Driver Unit shall conform to the specification.
- Be sure to write down the setting of parameters.
- Never modify the cable set.
- Lock the connectors securely and check for lose fixing screw(s).
- Please keep expendable parts and backup parts. (the Motor , the Driver Unit and Cable set for replace)
- Use alcohol for cleaning. Do not apply the thinner.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

(Blank Page)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

MEGATORQUE®
MOTOR
SYSTEM

User's Manual

NSK Ltd.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

(Blank Page)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

About This Manual

- Before operating the Megatorque Motor System, this manual should be read thoroughly. The Megatorque Motor System is a unique device, so 'common sense' based upon experience with servo motor may not apply here. Careful consideration of the mechanical design as described in "Chapter 6" is especially important.
- This manual describes the interface, function and operation of the Megatorque Motor System. This manual provides information on the ESA25 Driver Unit. If your model is not ESA25, contact NSK for respective information.

Technical Information

- For technical assistance and sales information, please contact your local NSK office. A list of NSK offices is provided in the back cover.

Megatorque Motor System Conformity to EC Directives (CE Marking)

NSK Ltd. declares that "Megatorque Motor System" conforms to EC Directive (CE Marking). However, please note that the following conditions are added for conformity to the EC Directives.

○ EC Declaration of Incorporation

- Megatorque Motor System is a machine component that is to be incorporated into the machine. (EC Declaration of Incorporation)
- The Megatorque Motor System must not be operated until it is incorporated into the machine.
- The Megatorque Motor System conforms to the following EC Directives as a machine component.
    - ◊ EC Machinery Directive 89/392 as amended 94/368 and 93/44.
    - ◊ EC Low Voltage Directive 73/23 as amended 93/68.
- The users have to take appropriate measures to their machines to conform to Electoromagnetic Compatibility Directive. The Megatorque Motor System must not be put into service until the machinery into which is to be incorporated has been declared in conformity with the provisions of the EC Directives.
- Our declaration becomes invalid if technical or operational modifications are introduced to the products without the consent of NSK Ltd.

○ Remaining Hazards (Following notes should be observed for your safety.)

- The Driver Unit must be used in the environmental condition of the Installation Category I and Pollution Degree 2. The Motor and the Driver Unit must be ground respectively.
- An isolation transformer must be used to prevent electrical shock. The isolation transformer shall have enough capacity for power consumption of the Megatorque Motor System.
- Install a noise filter in the primary AC power line as a measure against external noise.
- A thermal protection circuit for the Motor must be provided by the user to prevent the Motor from overheating.
- A circuit breaker must be installed into the primary AC power line of the Megatorque Motor System.
- The cables that connect the Motor and Driver Unit should be used only for internal wiring. Proper protection of the cables is obligated depending on the usage.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Terminology

It will be necessary to be familiar with some terms used in this document.

b.p.s.	bit per second; the unit of communication speed.
CCW	Motor rotating direction, counterclockwise; seen from the outside of rotor.
closed	logic output state; output current will flow.
CW	Motor rotating direction, clockwise; seen from the outside of rotor.
Driver Unit	means Megatorque Motor System's driver unit when capitalized.
Home Return	a built-in sequence program for setting the home position.
kpps	kilo pulse per second; the unit of pulse frequency.
Motor	means Megatorque Motor System's motor when capitalized.
OFF (all capital)	logic input state; input will see an open circuit.
ON (all capital)	logic input state; there will be a current path to the common DC supply.
open	logic output state; no output current
P control	proportional-only control; the servo algorithm.
PI control	proportional and integral control; the servo algorithm.
position gain	shorter name for position loop proportional gain
position integrator frequency	shorter name for position loop integrator cutoff frequency
position loop control mode	a control mode within the position control loop; P control or PI control available.
Programmable Indexer	Driver Unit's built-in indexing ability.
pulse train	a series of pulses used as a position command.
quadrature output	two pulse train outputs with 90û phase difference.
rated stall torque	the rated torque available at zero speed.
rated torque	the torque not to exceed the maximum Motor winding temperature.
s^{-1}	revolution per second; the unit of velocity.
s^{-2}	s^{-1} per second; the unit of acceleration.
servo-lock	one typical state of servo-on; the Motor provides torque and remains in position.
servo-off	the state where the Driver Unit provides no current to the Motor, and the Motor provides no torque. The Motor rotor can be rotated easily.
servo-on	the state that the Driver Unit is ready to control the Motor, or is controlling the Motor.
shipping set	a parameter setting or a Driver Unit function setting at shipping.
stall torque	the torque available at zero speed.
System	means Megatorque Motor System when capitalized.
velocity gain	shorter name for velocity loop proportional gain
velocity integrator frequency	shorter name for velocity loop integrator cutoff frequency
velocity loop control mode	a control mode within the velocity control loop; P control or PI control available.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Contents

1. Introduction ----------1-1
1.1. Overview ----------1-1
1.2. Functional Principle ----------1-3
1.2.1. Motor ----------1-3
1.2.2. Driver Unit ----------1-3

2. Notes to Users ----------2-1
2.1. Operational Remarks ----------2-1
2.2. Interchangeability of Motor and Driver Unit--------2-3

3. System Outline ----------3-1
3.1. System Configuration ----------3-1
3.2. Reference Number Configuration ----------3-2
3.2.1. Motor ----------3-2
3.2.2. Driver Unit ----------3-2
3.2.3. Cable Set ----------3-2
3.2.4. Handy Terminal ----------3-2
3.3. Standard Combination----------3-3
3.3.1. YS Series Motor----------3-3
3.3.1.1. Motor and Driver Unit----------3-3
3.3.1.2. Cable Set----------3-3
3.3.2. JS Series Motor ----------3-4
3.3.2.1. Motor and Driver Unit----------3-4
3.3.2.2. Cable Set----------3-4

4. Specifications ----------4-1
4.1. Motor Specifications ----------4-1
4.1.1. YS Series Motor----------4-1
4.1.1.1. Name of Parts ----------4-1
4.1.1.2. Specifications ----------4-2
4.1.1.3. Dimensions ----------4-6
4.1.2. JS Series Motor ----------4-17
4.1.2.1. Name of Parts ----------4-17
4.1.2.2. Specifications ----------4-17
4.1.2.3. Dimensions ----------4-19
4.2. Driver Unit----------4-23
4.2.1. Name of Parts ----------4-23
4.2.2. General Specifications ----------4-24
4.2.3. Functional Specifications ----------4-26
4.2.4. Jumper ----------4-28
4.2.5. Dimensions ----------4-29
4.3. Cable Set ----------4-30
4.3.1. Cable Set for YS Motor and JS Motor ------4-30
4.3.2. Cable Set for YS Motor with Brake ----------4-30
4.4. Handy Terminal ----------4-31
4.4.1. Name of Parts and Dimensions ----------4-31
4.4.2. Specification ----------4-32

5. Connector Specifications ----------5-1
5.1. CN1 : RS-232C Serial Communication Connector ---------- 5-1
5.1.1. CN1 Pin-Out---------- 5-1
5.1.2. CN1 Signal List---------- 5-1
5.1.3. Sample Wiring Diagram ---------- 5-2
5.2. CN2,CN5 : Control I/O Signal Connectors --------- 5-3
5.2.1. Pin- Out (CN2, CN5) ---------- 5-3
5.2.2. Signal Name and Function (CN2, CN5)----- 5-4
5.2.3. Setting the Polarity (A or B contact) of the Input Ports ---------- 5-6
5.2.4. Signal Specifications (CN2, CN5) ---------- 5-8
5.2.4.1. General Input ---------- 5-8
5.2.4.2. Pulse Train Input---------- 5-8
5.2.4.3. General Output---------- 5-9
5.2.4.4. Alarm Output---------- 5-9
5.2.4.5. Position Feedback----------5-10
5.2.4.6. Analog Command Input----------5-10
5.2.4.7. Analog Monitor Output----------5-11
5.2.5. Wiring Example (CN2, CN5) ----------5-12
5.2.5.1. Position Control Mode Wiring Example----------5-12
5.2.5.2. Wiring Example of Velocity Control/Torque Control Mode----------5-13
5.2.5.3. Wiring Example for YS Series Motor Equipped with Brake ----------5-14
5.3. CN3 : Resolver Cable Connector ----------5-17
5.3.1. CN3 Pin-out ----------5-17
5.3.2. CN3 Signal List----------5-17
5.4. CN4 : Motor Cable Connector ----------5-18
5.4.1. CN4 Pin-out ----------5-18
5.4.2. CN4 Signal List----------5-18
5.5. TB : Terminal Block for Power Supply----------5-19
5.5.1. Terminal List ----------5-19
5.5.2. Wiring Diagram (TB) ----------5-19

6. Installation----------6-1
6.1. Unpacking and Inspection ---------- 6-1
6.2. Combination of Motor and Driver Unit ---------- 6-2
6.3. Motor Mounting ---------- 6-3
6.3.1. Bearing Load---------- 6-4
6.3.1.1. Attaching the Load ---------- 6-4
6.3.1.2. Bearing Load ---------- 6-4
6.3.2. Using a “Dummy” Load---------- 6-5
6.3.3. Load Inertia---------- 6-7
6.3.4. Fluctuating Load Inertia ---------- 6-7
6.3.5. Motor Operating Condition ---------- 6-7

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

6.4. Driver Unit Mounting ----------6-8
6.4.1. Connecting Power----------6-9
6.4.2. Ground Connection and Wiring ----------6-11
6.4.3. Motor Thermal Protection ----------6-12
6.5. Connecting Motor and Driver Unit----------6-13
6.6. Power on and Servo on ----------6-14
6.6.1. Precautions ----------6-14
6.6.2. Turning Power on----------6-14
6.6.3. Turning Servo on ----------6-15

7. Handy Terminal Communication----------7-1
7.1. When Power is Turned on----------7-1
7.2. Command Entry----------7-2
7.2.1. Password ----------7-2
7.2.2. Canceling Command ----------7-3
7.2.3. Error----------7-3
7.2.4. Entering Parameter ----------7-4
7.2.5. Parameter That Requires Entry of Password----------7-4
7.3. Readout Command----------7-5
7.3.1. “TS” Command for Reading Set Value-------7-5
7.3.2. “?” Reading Function Command for Set Value ----------7-6

8. Tuning and Trial Running----------8-1
8.1. Tuning Procedure----------8-1
8.2. Automatic Tuning ----------8-2
8.2.1. Precautions ----------8-2
8.2.2. Initialize Servo Parameters ----------8-4
8.2.3. Execution of Automatic Tuning (Tuning Level 1)----------8-5
8.2.4. Trial Running (Tuning Level 1) ----------8-6
8.2.5. Servo Gain Minor Adjustment (Tuning Level 2)----------8-8
8.3. Manual Tuning----------8-10
8.3.1. Precautions ----------8-10
8.3.2. Adjustment of the Velocity Gain (VG)-------8-10
8.3.3. Adjustment of Velocity Integrator Frequency (VI)----------8-12
8.4. Setting Filters (Tuning Level 2)----------8-14

9. Operational Function----------9-1
9.1. General Operation and Function----------9-1
9.1.1. Servo “ON”----------9-1
9.1.2. Emergency Stop ----------9-2
9.1.3. Clearing Position Error Counter----------9-3
9.1.4. Integration off (IOFF)----------9-3
9.1.5. Over-travel Limit Switch----------9-4
9.1.5.1. Hardware Over-travel Limit Switch-----9-4
9.1.5.2. Software Over-travel Limit Switch------9-5
9.1.6. Alarm Output---------- 9-6
9.1.7. Brake Signal Output---------- 9-7
9.1.8. In-Position Output---------- 9-8
9.1.8.1. Output Signal Format---------- 9-9
9.1.8.2. Parameter “IN”----------9-10
9.1.8.3. Parameter “IS”----------9-10
9.1.8.4. “IPOS” Output in Special Occasion----------9-11
9.1.9. Position Feedback Signal----------9-12
9.1.10. Monitor Functions ----------9-13
9.1.10.1. Velocity Monitor----------9-14
9.1.10.2. Monitoring I/O State (IO) ----------9-15
9.1.10.3. Reading Current Position ----------9-18
9.1.10.4. Analog Monitor----------9-19
9.2. For More Advanced Operation ----------9-21
9.2.1. Position Scale----------9-21
9.2.1.1. Resolution ----------9-21
9.2.1.2. Direction of Position Scale ----------9-21
9.2.1.3. Types of Position Scale----------9-22
9.2.1.4. Position Scale Reset----------9-25
9.2.1.5. Example of Position Scale Setting ---9-25
9.2.2. Direction of Position Scale----------9-27
9.2.3. Digital Filter----------9-28
9.2.4. Feed Forward Compensation: FF----------9-29
9.2.5. Integrator Limit : ILV----------9-30
9.2.6. Dead Band Setting : DBP----------9-31
9.3. RS-232C Communication ----------9-32
9.3.1. Specification of Communication ----------9-32
9.3.2. Communication Procedure ----------9-32
9.3.2.1. When Power is Turned on----------9-32
9.3.2.2. Command Entry----------9-33
9.3.2.3. Password ----------9-34
9.3.2.4. Canceling Command ----------9-35
9.3.2.5. Error----------9-36
9.3.2.6. Readout Command ----------9-37
9.3.3. Communication with Personal Computer ----------9-39
9.3.3.1. Set-up of HyperTerminal----------9-39
9.3.3.2. Store Parameters of ESA Driver Unit ----------9-40
9.3.3.3. Transmit Stored Parameters to ESA Driver Unit----------9-40
9.3.4. Daisy Chain Communication----------9-41
9.3.4.1. Procedure to Set Daisy Chain Communication----------9-41
9.3.4.2. Initial Setting ----------9-42
9.3.4.3. Interfacing ----------9-42
9.3.4.4. Power on----------9-44
9.3.4.5. Operation ----------9-45

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

10. Operation ---------- 10-1
10.1. Preparation ---------- 10-1
10.1.1. Wiring Check ---------- 10-1
10.1.2. Procedure for Positioning Operation ------ 10-1
10.2. Position Control Mode Operation ---------- 10-2
10.2.1. Home Return ---------- 10-2
10.2.1.1. Home Return Parameter List -------- 10-5
10.2.1.2. Adjusting Home Position Switch and Home Offset Value ---------- 10-5
10.2.1.3. Programming Home Return Operation (example) ---------- 10-9
10.2.2. Programmable Indexer ---------- 10-10
10.2.2.1. Programmable Indexer Channel Switching ---------- 10-11
10.2.3. Pulse Train Command Operation -------- 10-12
10.2.3.1. Pulse Train Signal Format ---------- 10-12
10.2.3.2. Pulse Train Resolution ---------- 10-13
10.2.3.3. Input Timing ---------- 10-16
10.2.4. RS-232C Position Commands ---------- 10-17
10.2.5. Jog Operation ---------- 10-18
10.3. Velocity Control Mode Operation ---------- 10-19
10.3.1. RS-232C Communication Command --- 10-20
10.3.2. Analog Velocity Command ---------- 10-21
10.4. Torque Control Mode Operation ---------- 10-23
10.4.1. RS-232C Communication Command --- 10-23
10.4.2. Analog Torque Command ---------- 10-24

11. Programming ---------- 11-1
11.1. Commands and Parameters ---------- 11-2
11.2. Program Editing Command ---------- 11-5
11.3. Inputting a Program ---------- 11-6
11.4. Sample Program ---------- 11-8

12. Command and Parameter ---------- 12-1
12.1. List of Command and Parameter ---------- 12-1
12.2. Glossary ---------- 12-5
AB : I/O polarity ---------- 12-5
AC : Analog Command Mode ---------- 12-6
AD : Absolute Positioning, Degree ---------- 12-6
AG : Analog Command Gain ---------- 12-7
AN : Axis Number ---------- 12-7
AR : Absolute Positioning, Resolver --------- 12-8
AS : Ask Daisy Chain Status ---------- 12-8
AT : Automatic Tuning ---------- 12-8
AX : Axis Select ---------- 12-9
AZ : Absolute Zero Position Set ---------- 12-9
BM : Backspace Mode ---------- 12-9
CA : Channel Acceleration ---------- 12-10
CC : Clear Channel ---------- 12-10
CH : Channel Select ---------- 12-10
CL : Clear Alarm ---------- 12-10
CM : Communication Mode ---------- 12-11
CO : Position Error Counter Over Limit ---- 12-11
CR : Circular Resolution ---------- 12-11
CV : Channel Velocity ---------- 12-12
DB : Dead Band ---------- 12-12
DC : Digital RS-232C Command ---------- 12-13
DI : Direction Inversion ---------- 12-13
FC : Friction Compensation ---------- 12-13
FD : Feed Back Direction Mode ---------- 12-14
FF : Feed Forward Gain ---------- 12-14
FO : Low-pass Filter OFF Velocity ---------- 12-14
FP : Low-pass Filter, Primary ---------- 12-15
FR : Feed back Signal Resolution ---------- 12-15
FS : Low-pass Filter, Secondary ---------- 12-15
FW : FIN Width ---------- 12-16
FZ : Feedback Phase Z Configuration ---- 12-16
HA : Home Return Acceleration ---------- 12-16
HD : Home Return Direction ---------- 12-17
HO : Home Offset ---------- 12-17
HS : Home Return Start ---------- 12-17
HV : Home Return Velocity ---------- 12-17
HZ : Home Return Near-Zero Velocity ----- 12-18
ID : Incremental Positioning, Degree ----- 12-18
ILV : Integration Limit ---------- 12-18
IN : In-position ---------- 12-18
IO : Input /Output Monitor ---------- 12-19
IR : Incremental Positioning, Resolver --- 12-19
IS : In-position Stability Timer ---------- 12-19
JA : Jog Acceleration ---------- 12-20
JP : Jump ---------- 12-20
JV : Jog Velocity ---------- 12-20
LG : Lower Velocity Gain ---------- 12-21
LO : Load Inertia ---------- 12-21
LR : Low Torque Ripple ---------- 12-21
MA : Move Acceleration ---------- 12-22
MI : Read Motor ID ---------- 12-22
MM : Multi-line Mode ---------- 12-22
MN : Monitor ---------- 12-23
MO : Motor Off ---------- 12-23
MS : Motor Stop ---------- 12-23
MT : Factory Use Only ---------- 12-24
MV : Move Velocity ---------- 12-24
NP : Notch Filter, Primary (primary notch filter frequency) ------- 12-24
NS : Notch Filter, Secondary (secondary notch filter frequency) --- 12-25
NW : Neglect Width ---------- 12-25
OE : Sequence Option Edit ---------- 12-25
OG : Origin Set ---------- 12-26
OL : Overload Limit ---------- 12-26
OS : Origin Setting Mode ---------- 12-26

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

OTP : Overtravel Limit Switch Position ------ 12-26
OTM : Overtravel Limit Switch Position ----- 12-26
PA : Phase Adjust ---------- 12-27
PC : Pulse Command ---------- 12-27
PG : Position Gain ---------- 12-27
PH : Programmed Home Return ---------- 12-28
PS : Position Scale ---------- 12-28
RA : Read Analog Command ---------- 12-28
RC : Rated Current (Software Thermal) -- 12-29
RI : Factory Use Only ---------- 12-29
RR : Resolver Resolution ---------- 12-29
SE : Serial Error ---------- 12-29
SG : Servo Gain Adjust, Minor ---------- 12-30
SI : Set Initial Parameters ---------- 12-30
SL : Set Servo Loop ---------- 12-31
SM : Factory use only ---------- 12-31
SP : Start Program ---------- 12-31
SV : Servo-on ---------- 12-31
TA : Tell Alarm Status ---------- 12-32
TC : Tell Channel Program ---------- 12-33
TE : Tell Position Error Counter ---------- 12-33
TL : Torque Limit Rate ---------- 12-33
TP : Tell Position ---------- 12-34
TR : Tell RDC Position Data ---------- 12-34
TS : Tell Settings ---------- 12-35
VG : Velocity Gain ---------- 12-35
VI : Velocity Integrator Frequency --------- 12-36
VM : Velocity Integrator Mode ---------- 12-36
VO : Velocity Error Over Limit ---------- 12-36
VW : Velocity Error Over Limit Width ------- 12-37
WD : Write Data to EEPROM ---------- 12-37
WM : Write Mode to EEPROM ---------- 12-37
ZP : Factory Use Only ---------- 12-38
ZV : Factory Use Only ---------- 12-38

13. Maintenance ---------- 13-1
13.1. Precautions ---------- 13-1
13.2. Maintenance Check ---------- 13-2
13.2.1. Motor ---------- 13-2
13.2.2. Driver Unit and Cable Set ---------- 13-2
13.3. Periodical Replacement of Parts ---------- 13-3
13.3.1. Motor ---------- 13-3
13.3.2. Driver Unit ---------- 13-3
13.4. Storing ---------- 13-3
13.5. Warranty Period and Covering Range ---------- 13-4
13.5.1. Warranty Period ---------- 13-4
13.5.2. Range of Warranty ---------- 13-4
13.5.3. Immunities ---------- 13-4
13.5.4. Service Fee ---------- 13-4

14. Alarm ---------- 14-1
14.1. Identifying Alarm ---------- 14-1
14.1.1. LED Alarm Indicator ---------- 14-1
14.1.2. Using TA Command ---------- 14-2
14.1.3. Alarm Code List ---------- 14-3
14.2. Description of Alarm ---------- 14-4
14.2.1. Normal State ---------- 14-4
14.2.2. Alarms Related to Power Amplifier -------- 14-4
14.2.2.1. Heat Sink Overheat or Regeneration Resistor Overheat ------ 14-4
14.2.2.2. Abnormal Main AC Line Voltage ---- 14-5
14.2.2.3. Over Current ---------- 14-5
14.2.2.4. Control AC Line Under-Voltage ----- 14-6
14.2.3. Alarms Related to Motor ---------- 14-7
14.2.3.1. Resolver Circuit Error ---------- 14-7
14.2.3.2. Software Thermal Sensor ---------- 14-7
14.2.3.3. Velocity Error Over ---------- 14-8
14.2.4. Alarms Related to Control ---------- 14-9
14.2.4.1. Memory Error ---------- 14-9
14.2.4.2. EEPROM Error ---------- 14-9
14.2.4.3. System Error ---------- 14-9
14.2.4.4. CPU Error ---------- 14-10
14.2.4.5. Interface Error ---------- 14-10
14.2.4.6. Analog Command Error ---------- 14-10
14.2.4.7. Excess Position Error ---------- 14-11
14.2.4.8. Software Over Travel Limit --------- 14-11
14.2.4.9. Hardware Over Travel Limit -------- 14-12
14.2.4.10. Emergency Stop ---------- 14-12
14.2.4.11. Program Error ---------- 14-12
14.2.4.12. Automatic Tuning Error ---------- 14-13
14.2.4.13. RS-232C Error ---------- 14-13
14.2.4.14. CPU Error ---------- 14-14
14.2.5. History of Alarm ---------- 14-15
14.2.5.1. Indication of History of Alarm ------ 14-15
14.2.5.2. Clear History of Alarm ---------- 14-15

15. Troubleshooting ---------- 15-1
15.1. Identifying Problem ---------- 15-1
15.2. Troubleshooting ---------- 15-2
15.2.1. Power Trouble ---------- 15-3
15.2.2. Motor Trouble ---------- 15-4
15.2.3. Command Trouble ---------- 15-6
15.2.4. Terminal Trouble ---------- 15-10

Appendix
Appendix 1: Verify Input / Output Signal ---------- A-1
Appendix 2 : How to Check Motor Condition ---------- A-5
Appendix 3 : Initializing Driver Unit ---------- A-9
Appendix 4 : How to Replace ESA25 Driver Unit ----- A-11
Appendix 5 : Regeneration Dump Resistor ---------- A-18
Appendix 6: Brake Built in YS Series Motor ---------- A-19
Appendix 7: Parameter • Program Setting List -------- A-23

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

1. Introduction

- This section is to introduce the Megatorque Motor System in general. Some parts of explanations are not applicable to all Driver Units and/or Motors. Refer to respective specifications when ordering.

1.1. Overview

- The Megatorque Motor System is a unique actuator with special capabilities. The System consists of almost all elements that are needed for a complete closed loop servo motor system. With conventional technology these parts must be purchased and installed separately, but the Megatorque Motor System incorporates them all into two units; the Motor and the Driver Unit.

Motor

- The Motor consists of a high torque brushless actuator, a high resolution brushless resolver, and a heavy duty precision NSK bearing. The high torque actuator eliminates the need for gear reduction, while the built-in resolver usually makes feedback components, such as encoders or tachometers unnecessary. Finally the heavy duty bearing eliminates the need for separate mechanical support since the Motor case can very often support the load directly in most applications.

Driver Unit

- The Driver Unit consists of a power amplifier, resolver interface, and digital motor control circuits. The Driver Unit provides everything that is needed to control the Motor's torque, velocity, or position; for interface to any standard motor position controller or to act as a stand-alone digital motion control system with its built-in zero backlash position control capability.

High Speed

- The Driver Unit features higher speeds than ever before... with less torque drop-off at the intermediate speeds. As a result, smaller Motors may be used for high speed indexing applications when the torque requirement is primarily for acceleration.

Ease of Use

- The digital control makes the System easy to use, for more than one reason:
  - ◊ The circuit parameters can be changed by an RS-232C command, rather than by attempting to adjust a multi-turn pot or changing capacitor values. The parameter changes are not only a breeze to make, but they are measurable and repeatable, so that every System behaves the same way, every time.
  - ◊ The versatile design means that significant changes in the Driver Unit function can be made with little or no hardware changes. Numerous options are available at little or no extra cost.
  - ◊ Stand-alone capability means that the Megatorque Motor System can be operated in position control mode without the need for a separate CNC or position controller. Built-in software for flexible motion control means that the complexity of the electronic system can be cut in half. This reduction of the controls circuitry to one component saves time and money.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Universal Interface

- Because of the extreme versatility of the Driver Unit design, a wide variety of interface methods are possible. The Megatorque Motor System can be interfaced to virtually any control system. It is very easy to control the Megatorque Motor System with a CNC, a servo motor controller, a robot controller, or an indexing controller. You can operate the Megatorque Motor System with a stepper motor controller or with a personal computer or dumb terminal. Versatile position control can even be implemented with a single switch!

High Repeatability

- With zero backlash, direct drive and a 614 400count/rev resolver, the Megatorque Motor System offers repeatability as high as approximately 2.1”, or approximately 0.00058°. With no mechanical contact or moving parts other than the bearing, this repeatability will never degrade.

Easy to Maintain

- With all adjustments, indicators, and test points accessible by the front panel, service or maintenance is easy. LED (light-emitting diode) and logic diagnostic outputs identify the nature of any error condition quickly and accurately.

- Together, the Motor and the Driver Unit provide the ultimate in simplicity for precise and reliable motion control.

Single Component Servo System

- A conventional brushless servo system requires at least several separate components which must be selected and packaged together, often at great expense. Furthermore, many of these components introduce problems of their own to degrade the entire system’s performance. Gears and flexible couplings, for example, introduce mechanical irregularities such as windup, backlash, and mechanical inaccuracy. The same functions can be accomplished with just two components using the Megatorque Motor System; all of the circuits needed to implement a position or velocity control servo loop (digital motion controller, servo compensation, brushless commutation logic, power amplifier) are included in the Driver Unit, and all of the mechanical components that were required (motor, couplings, gears, bearings, tachometer and encoder) are either replaced or made unnecessary by the Motor.

Gearless Advantage

- There are many advantages to the gearless servo system. One advantage is to eliminate backlash, the angular play due to looseness of fit between two mating gears. The direct drive inherently eliminates backlash, so that repeatability is limited only by the resolution of the position sensor. The direct drive permits direct coupling of the Motor and the load, so that troublesome flexible couplings are not required. This permits tighter, more direct control of the load. The Megatorque Motor System has a very high torque to inertia ratio, so that very high acceleration rates can be achieved. When the load inertia is low, the Motor can accelerate a load as much as 10 times faster than comparable high performance servo systems using gears. The performance advantages of the Megatorque Motor System are demonstrated by many of the new class of the direct drive robots which have established repeatability and speed records in the robot industry and are the performance standards against which other robot systems are compared.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

1.2. Functional Principle

1.2.1. Motor

- By virtue of its unique design, the Megatorque Motor System is capable of producing extremely high torque at low speeds suitable for direct drive applications. Furthermore, it can produce these torque levels without using an undue amount of power, so it can sustain these torque levels indefinitely under most conditions without overheating.

Motor Construction

- This Motor is of dual stator construction with rotor between them. Each stator is constructed of laminated iron sheets with eighteen poles stamped into the laminations. Each pole has one set of copper windings around it which provide the magnetic field. The windings are wired in series so that there are three sets of windings seen by the power amplifier, each winding consisting of six (four for 0408 type Motor) pole pieces. The face of each pole piece has many teeth, resembling a stepping motor (in appearance, not in function). The teeth serve to focus the magnetic energy into a series of discrete points along the pole face. In total there are hundreds of these points around the full turn of the Motor. (The number depends upon the Motor size.) The rotor is a thin cylindrical ring, constructed of the same iron laminations and with the same tooth structure, but without windings or pole pieces. The rotor serves to conduct the magnetic field from the inner stator across the rotor to the adjacent pole piece on the outer stator, and back again. The rotor teeth also serve to focus the magnetic field into discrete points around the circumference of the rotor, and the combined effect of these points of focused magnetic field around both the stators and the rotor act like electronic gear reduction, multiplying the torque hundreds of times while reducing the speed by the same amount.

Brushless Microprocessor Commutation

- For each full electrical cycle of commutation, the Motor rotates through one magnetic cycle which is the angular distance between adjacent teeth. In most Motor sizes, there are 150 electrical cycles per Motor revolution; some smaller sizes such as 0408 type have 100 cycles per revolution. The commutation of the Motor phases is performed without brushes by direct control of a high speed microprocessor in the Driver Unit, and it is the phase relationship of the three Motor phases, not current polarity, that determine the direction of rotation.

Why No Magnets?

- No magnets are used in the Motor, since the Motor uses the teeth to focus the magnetic field. This contributes to the robustness of the Motor and to the high torque levels which are produced. Since demagnetization is not a worry, it is possible to develop high magnetic flux densities within the Motor which would weaken permanent magnets. Unlike motors which use permanent magnets, the Megatorque Motors do not weaken with age.

1.2.2. Driver Unit

- All of the circuits that are needed to operate the Megatorque Motor System in position, velocity or torque control modes are contained in the Driver Unit. These circuit functions are:
    - ◊ Digital microprocessor
    - ◊ Power amplifier
    - ◊ Resolver interface
- The resolver interface and the digital microprocessor are on the control board, a single printed circuit board which is accessible to you on the right side of the Driver Unit.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Digital Microprocessor Subsystem

- The digital microprocessor subsystem is a part of the control board. All analog signals are converted to digital form, and the 16-bit microprocessor on the control board handles all Motor control functions in the digital domain. Since analog circuits are eliminated, there are no pots to adjust, no operational amplifier circuits to tweak, and no soldering or component changes are required. The digital microprocessor receives commands from the outside world in either analog or digital form, depending upon the selected interface option. The command parameter can be position, velocity, or torque. The digital microprocessor compares the commanded variable with the actual measured value of the controlled variable, and makes small corrections continuously so that the Motor always obeys the command. The digital microprocessor receives its feedback information from the Motor's built-in resolver via the resolver interface circuit subsystem. Digital filters may be applied which alter Motor behavior to improve the repeatability, or to eliminate mechanical resonances:
    - ◊ A digital integrating function may be selected which improves the repeatability of the Motor by making it respond to very small command signals. With the integrator, the Motor can provide zero position error even under full load torque.
    - ◊ A digital notch filter may be employed to cut out certain frequencies from the Motor response so that mechanical resonances will not cause the Motor to oscillate. If the Motor is attached to a load which has a strong natural frequency of oscillation, the Motor can be made insensitive to it merely by setting the notch frequency to the same frequency. A 100Hz resonance can be eliminated, for instance, simply by initializing the Driver Unit with the RS-232C command "NP100".
    - ◊ A digital low-pass filter may be employed to modify Motor frequency response and make the Motor smooth and quiet. Again, the low-pass filter is implemented digitally, and setting up the filter frequency is as simple as asking for it. There are two independent low-pass filters available.

Brushless Microprocessor Commutation

- The digital microprocessor uses the digitized position information obtained from the resolver interface to determine when to apply current to the Motor phases, and how much. The amount of current applied to each Motor phase is determined by a mathematical function that takes into account the torque command level, the Motor position, and the Motor velocity. These factors are taken into account to compensate for the Motor non-linearity and to produce a smooth output torque.

Power Amplifier Subsystem

- The Motor windings are driven by a current regulated unipolar switching power amplifier that delivers the current designated by the commutation logic circuits to each of the Motor phases. The power amplifier monitors its internal voltages to protect itself from damage. If the AC line is too high or too low, the power amplifier will disable itself and activate alarm indicators. If the amplifier's internal DC bus voltage is too high as a result of Motor regeneration, the monitor circuits will switch on a power resistor to dissipate some of that excess energy. If the power amplifier temperature is too high, it will activate an alarm signal. For any of the alarm conditions, the type of the alarm is communicated back to the digital microprocessor, which activates the alarm condition indicators to identify the specific nature of the alarm condition.

Resolver Interface Subsystem

- Position and velocity feedback signals are provided by the resolver interface circuit. This circuit provides the excitation signal to the resolver, and receives the three phase resolver analog signals. These signals are decoded by the resolver-to- digital converter (RDC) to produce digital cyclic absolute position and velocity feedback signals. The cyclic absolute position data is used by the commutation circuits and is used internally to maintain absolute position data.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

2. Notes to Users

- This manual describes the interface, function, and operation of the Megatorque Motor System with the ESA25 Driver Unit.

- Before operating the Megatorque Motor System for the first time, this manual should be read thoroughly.

- Motors, Driver Units and Cable sets described in this manual are interchangeable.

- For motors, this manual describes the standard Motor of YS and JS series only.
  If your motor is not one of these, please refer to the respective specification document to which the priority is given.

- Following notice is added to the clause of safety precautions to get your attention.

  Danger : Might cause serious injuries

  Warning : Might result in injuries

  Caution : Might damage the equipment (machine) and/or the load attached to the motor (work or end effector), or might cause malfunction of the system.

2.1. Operational Remarks

- Pay special attention to the following precautions when installing, adjusting, checking and troubleshooting Megatorque Motor System.

  Caution : Make sure that Motor size, maximum torque number of Motor and Driver Unit are the same. Refer to "3.3. Standard Combination" for the details.

  - ◊ *Parameters of Driver Unit are set to Motor size and maximum torque before shipped.*
  - ◊ *If the numbers are different, the system does not operate properly.*

  Caution : Do not make Cable Set shorter or longer. Changing the length may worsen Motor and Driver Unit performance.

  Caution : Do not disassemble the Motor since it is precisely adjusted and assembled. If disassembled, it may cause abnormalities such as deterioration in accuracy and rigidity as well as noise.

  Caution : Be sure to connect the Emergency stop signal circuit to the EMST port of the control I/O connector.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Caution : *Do not touch Driver Unit. Touching the Driver Unit just after the power is turned off may cause electric shock.*

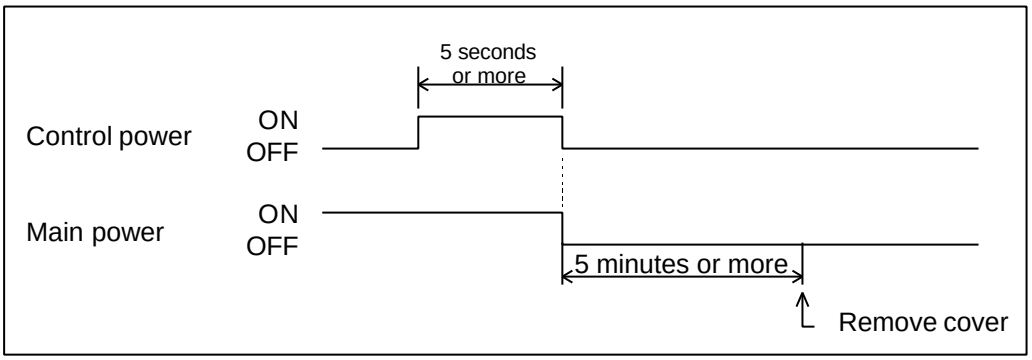
◊ *Driver Unit has high capacity conductors in its internal circuits and there is high residual voltage for few minutes after the power is turned off.*

◊ *Do not detach a cover of Driver Unit unless it is necessary. When a cover has to be removed, follow procedures described bellow.*

1) Turn off the control and main power. If only main power has been turned on, turn the control power on for more than 5 seconds, then turn off both powers.
Neglecting this procedure is very dangerous. The procedure is to reduce residual voltage of capacitors.

2) Wait for 5 minutes or more, then remove the cover.

Figure 2-1



Caution : *Use of the optional regenerative dump resistor shall be considered for heavy duty operation .*

◊ *When the Motor is decelerating, rotational energy is dissipated by internal dump resistor. Excessive rotational energy causes very high regeneration of the Motor, the dump resistor is overheated, then the alarms goes off and the Motor stops.*

◊ *Gentler deceleration rate or decreasing duty cycle prevents overheating of the dump resistor.*

◊ *If heavy duty operation is still needed, installation of optional "Regenerative Dump Resistor" is recommended. Refer to "Appendix 6" for the details.*

Danger : *Never apply any water or oil to the Driver Unit. Take appropriate measures to protect the Driver Unit from water, oil, slag, dust and corrosive gas.*

Warning : *Do not conduct an "Isolation test" or "Megger test" on the Driver Unit. It may damage the internal circuit.*

Caution : *Be sure to adjust the servo parameters according to conditions of actual use. In most cases, the Direct Drive Motor System cannot exhibit its full performance unless the shipping set of these parameters are not altered. Refer to "8. Tuning and Trial Running" for the details of parameter setting.*

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

2.2. Interchangeability of Motor and Driver Unit

Interchangeable combination

- Standard ESA 25 Driver Unit has the interchangeability to the Motor. You may use any Driver Unit for a Motor regardless of serial number.
- However, refer to “3.3. Standard Combination” for combination of Motor, Driver Unit and Cable set.

Non-interchangeable combination

- Motor and Driver Unit is not interchangeable for a combination specially arranged. In such a case refer to the respective specifications sheet.
- Be sure to have the same serial number of the Motor and Driver Unit for a combination. Use a specially made cable set as well.
- When Motor and Driver Unit do not have the same serial number in a combination or the cable length is changed by user, be fully aware that the Megatorque Motor system may not conform to the specifications.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

(Blank Page)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3. System Outline

3.1. System Configuration

Figure 3-1 : System configuration (without brake)

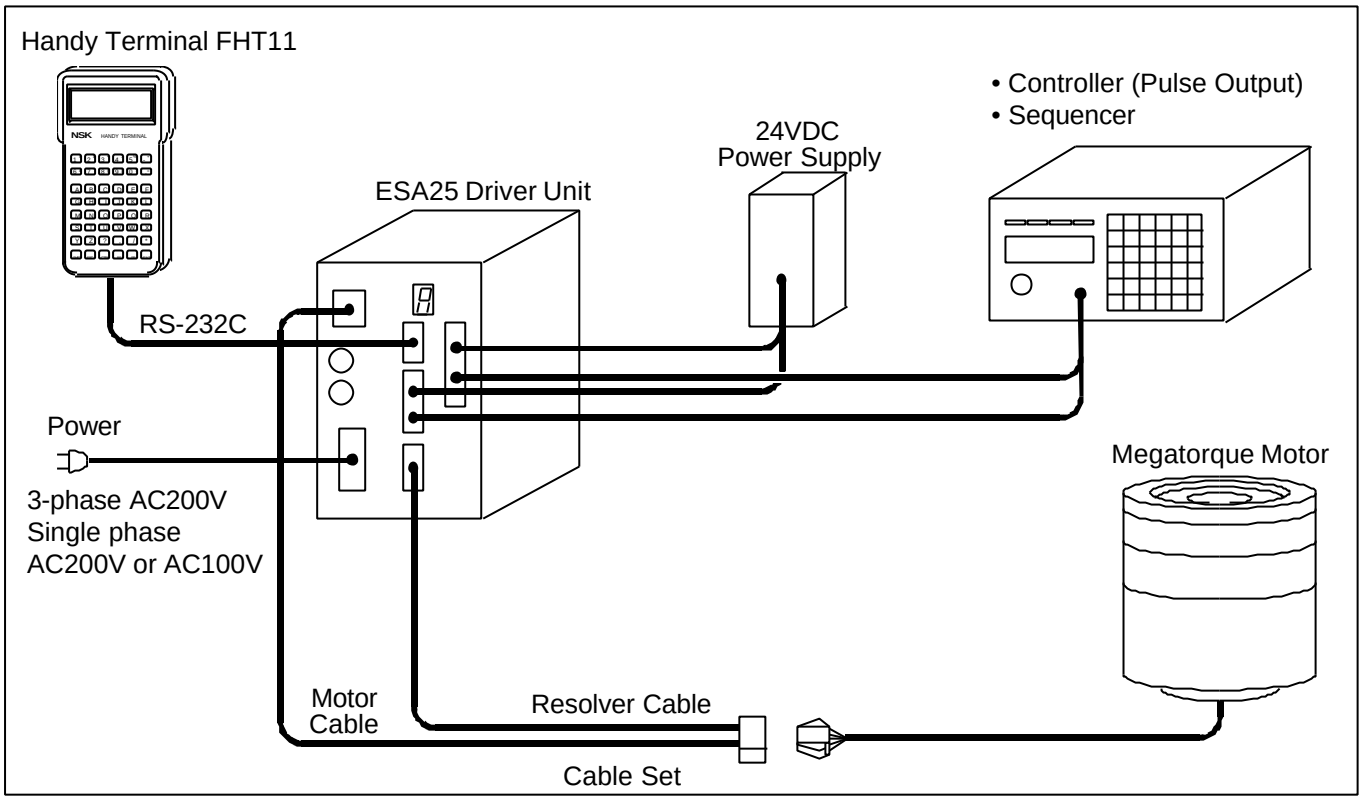
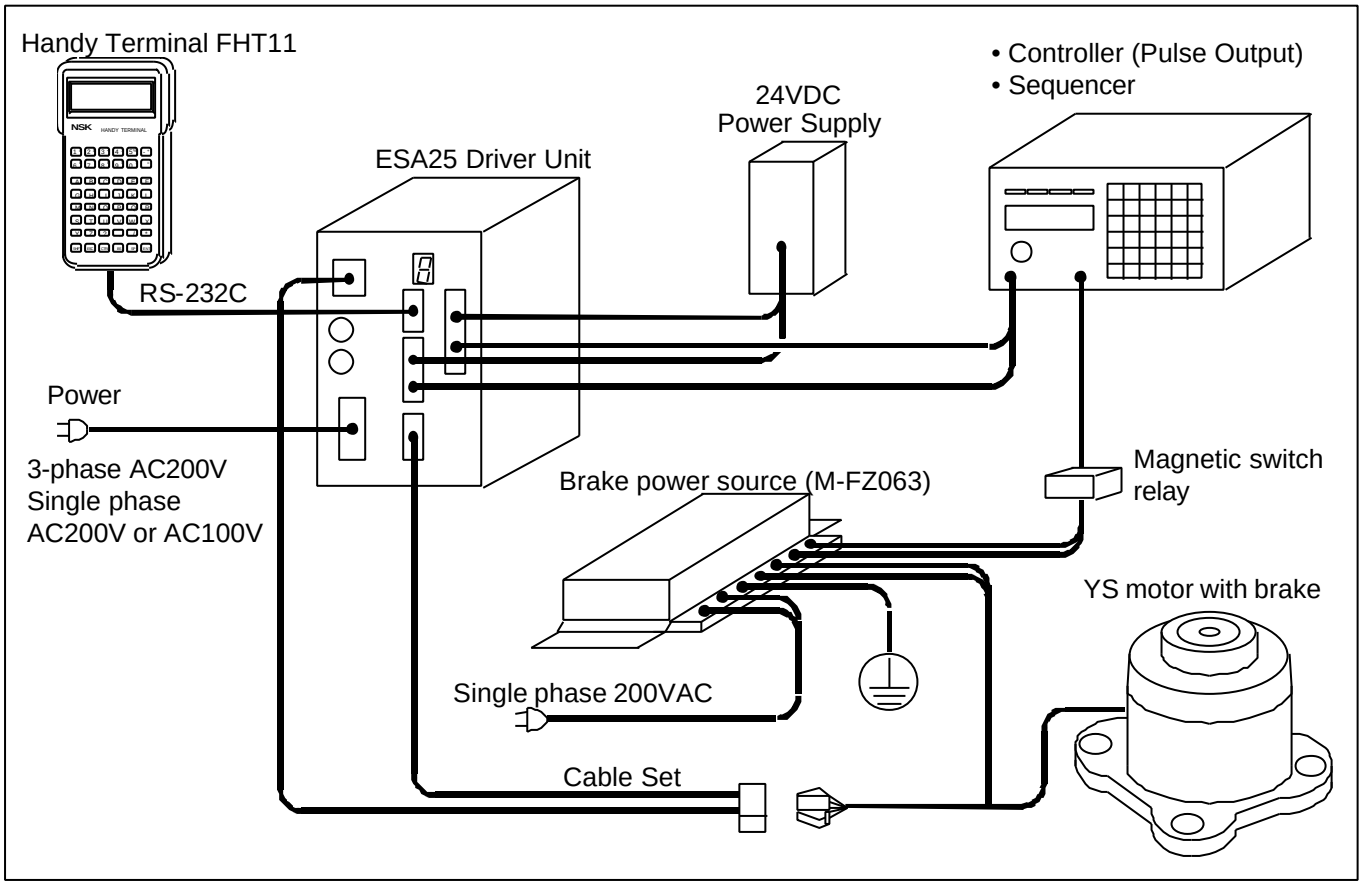


Figure 3-2 : System configuration with brake



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3.2. Reference Number Configuration

3.2.1. Motor

Figure 3-3

M-YS	**-**	**2**	**020**	**GN**	**001**
(1)		(2)	(3)	(4)	(5)
M-JS	**-**	**2**	**006**	**GN**	**510**

(1) Megatorque Motor series
(2) Motor size
(3) Maximum torque (Unit: N·m)
(4) GN : Standard
*GG : With brake
(5) Design number

* Brake is only available for YS series.

3.2.2. Driver Unit

Figure 3-4

M-ESA	**-**	**Y2**	**020**	**T**	**25**
(1)		(2)	(3)	(4)	(5)
M-ESA	**-**	**J2**	**006**	**T**	**25**

(1) ESA Driver Unit
(2) Motor series and size
(3) Maximum torque (Unit: N·m)
(4) Main power supply
V: AC100V
T: AC200V
(5) Denotes ESA25 standard (25)

3.2.3. Cable Set

Figure 3-5

M-C	**-**	**004**	**SS**	**29**
(1)		(2)	(3)	(4)
M-C	**-**	**004**	**SS**	**29**

(1) Megatorque Motor Cable Set
(2) Cable length (Unit: m)
Refer to “3.3. Standard Combination” for standard length
(3) Cable Set for ESA25 Driver Unit
(4) Cable design number
YS motor : 29 (Standard),
28 (With brake)
JS motor : 29 (Standard)

3.2.4. Handy Terminal

Figure 3-6

M-FHT	**11**
(1)	(2)

(1) Handy Terminal
(2) Design number

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3.3. Standard Combination

- This section describes “Standard Combination” of the Motor, ESA25 Driver Unit and Cable set.
- Make sure to select right combination of each parts when ordering.

3.3.1. YS Series Motor

3.3.1.1. Motor and Driver Unit

Table 3-1

Motor Reference No.	ESA25 Driver Unit Reference No.	Power Supply Voltage
M-YS2005GN001	M-ESA-Y2005V25	AC100V
	M-ESA-Y2005T25	AC200V
M-YS2020GG001 M-YS2020GN001	M-ESA-Y2020V25	AC100V
	M-ESA-Y2020T25	AC200V
M-YS3008GN001	M-ESA-Y3008V25	AC100V
	M-ESA-Y3008T25	AC200V
M-YS3040GG001 M-YS3040GN501	M-ESA-Y3040V25	AC100V
	M-ESA-Y3040T25	AC200V
M-YS4080GG001 M-YS4080GN001	M-ESA-Y4080V25	AC100V
	M-ESA-Y4080T25	AC200V
M-YS5120GG001 M-YS5120GN001	M-ESA-Y5120V25	AC100V
	M-ESA-Y5120T25	AC200V
M-YS5240GN001	M-ESA-Y5240T25	AC200V

3.3.1.2. Cable Set

Table 3-2 : Standard

Reference No.	Length
M-C002SS29	2m
M-C004SS29	4m
M-C008SS29	8m
M-C015SS29	15m
M-C030SS29	30m

Table 3-3 : Motor with brake

Reference No.	Length
M-C002SS28	2m
M-C004SS28	4m
M-C008SS28	8m
M-C015SS28	15m
M-C030SS28	30m

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3.3.2. JS Series Motor

3.3.2.1. Motor and Driver Unit

Table 3-4

Motor Reference No.	ESA25 Driver Unit Reference No.	Power Supply Voltage
M-JS0002GN510	M-ESA-J0002V25	AC100V
	M-ESA-J0002T25	AC200V
M-JS1003GN510	M-ESA-J1003V25	AC100V
	M-ESA-J1003T25	AC200V
M-JS2006GN510	M-ESA-J2006V25	AC100V
	M-ESA-J2006T25	AC200V
M-JS2014GN510	M-ESA-J2014V25	AC100V
	M-ESA-J2014T25	AC200V

3.3.2.2. Cable Set

Table 3-5

Reference No.	Length
M-C002SS29	2m
M-C004SS29	4m
M-C008SS29	8m
M-C015SS29	15m
M-C030SS29	30m

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

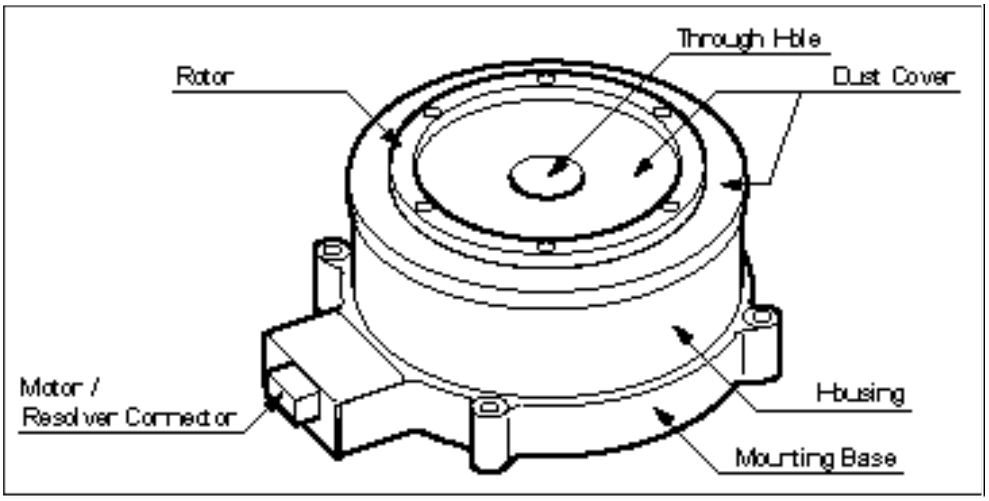
4. Specifications

4.1. Motor Specifications

4.1.1. YS Series Motor

4.1.1.1. Name of Parts

Figure 4-1



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

4.1.1.2. Specifications

- There are three types of Motor in YS series.
  - 1 Standard
  - 2 Motor with brake
  - 3 Low profile type

- YS Series Motor can be run on either 100V/110V or 200V/220V AC.

- The unit used in the specification tables is in SI unit system
  1N = 0.102 kgf = 0.225lb
  1N·m = 0.102 kgf·m = 0.738 ft·lb

1 Standard

Table 4-1 : Standard

Item (Unit) \ Motor reference No.		M-YS2020 GN001	M-YS3040 GN501	M-YS4080 GN001	M-YS5120 GN001	M-YS5240 GN001
Maximum torque	(N·m)	20	40	80	120	240
Maximum current/phase	(A)	6				
Allowable axial load	(N)	3 700	4 500	9 500	19 600	19 600
Allowable moment load	(N·m)	60	80	160	400	400
Axial rigidity Note (1)	(mm/N)	4.0×10^{-6}	3.0×10^{-6}	1.4×10^{-6}	1.0×10^{-6}	1.0×10^{-6}
Moment rigidity Note (1)	(rad/N·m)	3.5×10^{-6}	2.5×10^{-6}	1.5×10^{-6}	3.0×10^{-7}	3.0×10^{-7}
Maximum stall torque	(N·m)	15	35	70	105	198
Rotor moment of inertia	($kg \cdot m^2$)	0.007	0.020	0.065	0.212	0.255
Mass	(kg)	10	16	29	55	95
Operating condition		IP30 Note (3)	IP20	IP30	IP30	IP30
		Temperature: 0~40°C, Humidity: 20~80 %, Use indoors, free from dust, condensation and corrosive gases.				
Maximum speed	[s^{-1} (rps)]	3				
Resolver resolution	(pulse/r)	614 400				
Positioning accuracy	(sec)	150 Note (2)				
Repeatability	(sec)	±2.1				
Compatible Driver Unit	AC 200V	M-ESA-Y2020T25	M-ESA-Y3040T25	M-ESA-Y4080T25	M-ESA-Y5120T25	M-ESA-Y5240T25
	AC 100V	M-ESA-Y2020V25	M-ESA-Y3040V25	M-ESA-Y4080V25	M-ESA-Y5120V25	–

Note : (1) These value assume that the Motor is mounted on a rigid base.

(2) When used with an ESA25 Driver Unit (interchangeable).

(3) Internal Protection Level.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

2 Motor with brake

Table 4-2 : Motor with brake

Item (Unit) \ Motor reference No.		M-YS2020GG001	M-YS3040GG001	M-YS4080GG001	M-YS5120GG001
Maximum torque	(N·m)	20	40	80	120
Maximum current/phase	(A)	6			
Allowable axial load	(N)	3700	4500	9500	19600
Allowable moment load	(N·m)	60	80	160	400
Axial rigidity Note (1)	(mm/N)	4.0×10^{-6}	3.0×10^{-6}	1.4×10^{-6}	1.0×10^{-6}
Moment rigidity Note (1)	(rad/N·m)	3.5×10^{-6}	2.5×10^{-6}	1.5×10^{-6}	3.0×10^{-7}
Maximum stall torque	(N·m)	15	35	70	105
Rotor moment of inertia	($kg \cdot m^2$)	0.008	0.023	0.072	0.240
Brake torque	(N·m)	20	40	80	120
Mass	(kg)	12	20	36	66
Operating condition		IP30 Note (3)	IP30	IP30	IP30
		Temperature: 0~40°C, Humidity: 20~80 % , Use indoors, free from dust, condensation and corrosive gases.			
Maximum speed	[s^{-1} (rps)]	3			
Resolver resolution	(pulse/r)	614 400			
Positioning accuracy	(sec)	150 Note (2)			
Repeatability	(sec)	±2.1			
Compatible Driver Unit	AC 200V	M-ESA-Y2020T25	M-ESA-Y3040T25	M-ESA-Y4080T25	M-ESA-Y5120T25
	AC 100V	M-ESA-Y2020V25	M-ESA-Y3040V25	M-ESA-Y4080V25	M-ESA-Y5120V25

Note : (1) These value assume that the Motor is mounted on a rigid base.

(2) When used with an ESA25 Driver Unit (interchangeable).

(3) Internal Protection Level.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3 Low profile type

Table 4-3 : YS low profile type

Item (Unit) \ Motor reference No.		M-YS2005GN001	M-YS3008GN001
Maximum torque	(N·m)	5	8
Maximum current/phase	(A)	1.5	
Allowable axial load	(N)	3700	4500
Allowable moment load	(N·m)	60	80
Axial rigidity Note (1)	(mm/N)	2.8×10^{-5}	2.6×10^{-5}
Moment rigidity Note (1)	(rad/N·m)	1.8×10^{-5}	1.5×10^{-5}
Maximum stall torque	(N·m)	4	5
Rotor moment of inertia	($kg \cdot m^2$)	0.003	0.006
Mass	(kg)	4	6
Operating condition		IP20 Note (3)	IP20
		Temperature: 0~40°C, Humidity: 20~80 % , Use indoors, free from dust, condensation and corrosive gases.	
Maximum speed	[S^{-1} (rps)]	3	2/3 Note (4)
Resolver resolution	(pulse/r)	614 400	
Positioning accuracy	(sec)	150 Note (2)	
Repeatability	(sec)	±2.1	
Compatible Driver Unit	AC 200V	M-ESA-Y2005T25	M-ESA-Y3008T25
	AC 100V	M-ESA-Y2005V25	M-ESA-Y3008V25

Note : (1) These value assume that the Motor is mounted on a rigid base.
(2) When used with an ESA25 Driver Unit (interchangeable).
(3) Internal Protection Level.
(4) Differs with main power voltage. 2 : AC100V, 3 : 2AC00V

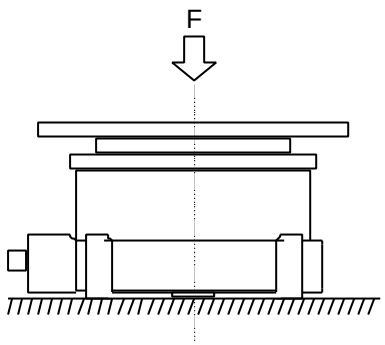
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

◆ How to calculate axial and moment load

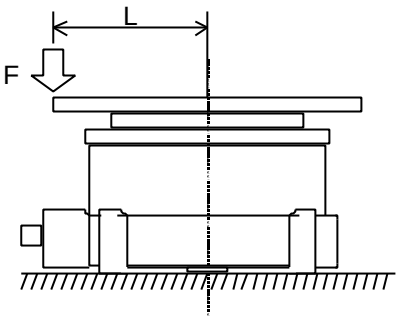
Caution : *• Do not apply excessive load to the Motor.*
An excessive load more than specified in Table 4-2 may result in premature Motor failure.

• Followings show how to calculate the loads.

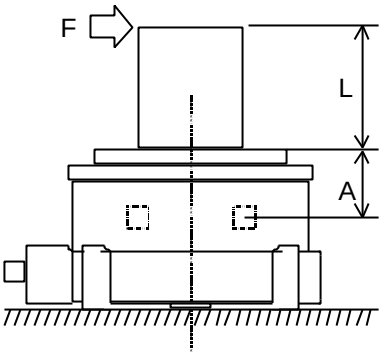
Figure 4-2 : How to calculate loads



If F is an external force, then
- Axial load Fa = F + weight of payload
- Moment load M = 0



If F is an external force, then
- Axial load Fa = F + weight of payload
- Moment load M = F × L



If F is an external force, then
- Axial load Fa = weight of payload
- Moment load M = F × (L+A)

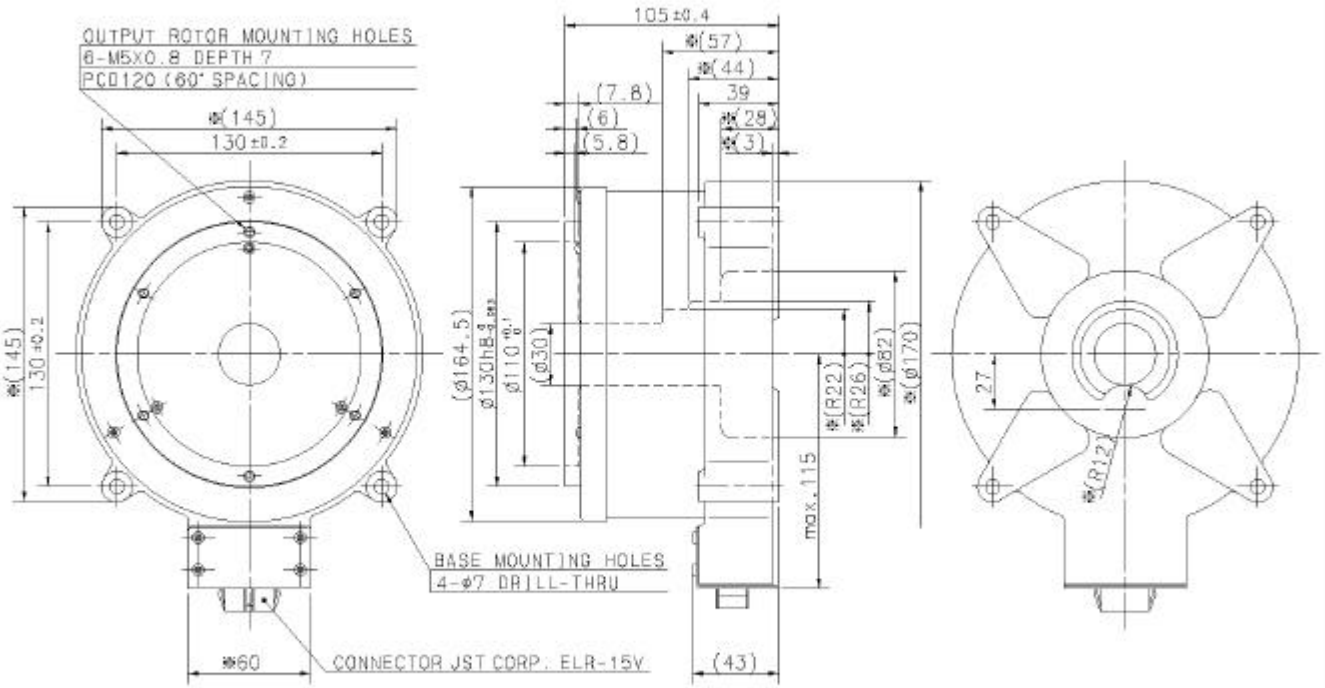
Motor reference number	M-YS2005	M-YS2020	M-YS3008	M-YS3040	M-YS4080	M-YS5120	M-YS5240
Dimension A (mm)	26.0	46.5	25.5	52.5	54.0	58.5	58.5

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

4.1.1.3. Dimensions

1 Standard

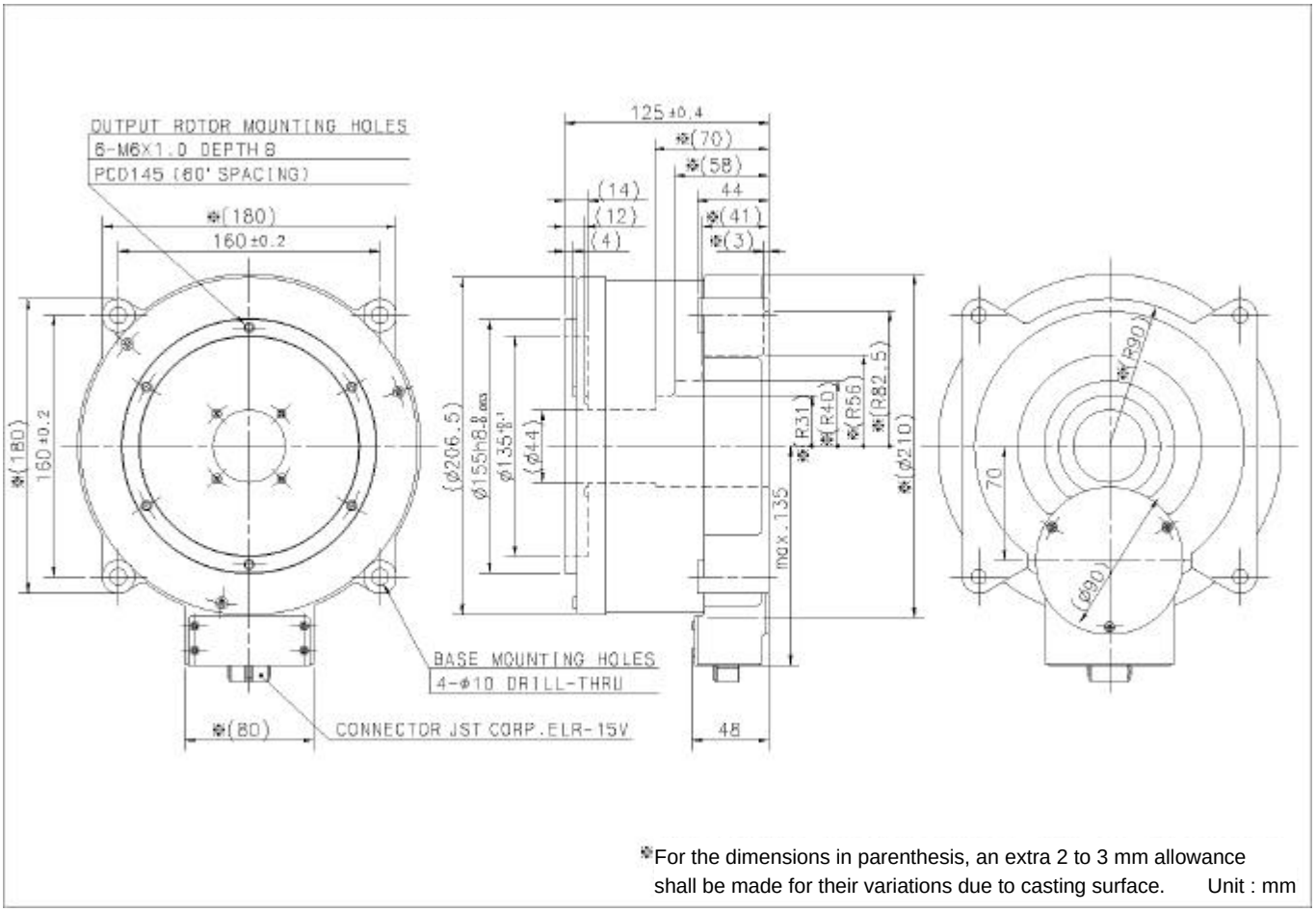
Figure 4-3 : M-YS2020GN001



※For the dimensions in parenthesis, an extra 2 to 3 mm allowance shall be made for their variations due to casting surface. Unit : mm

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

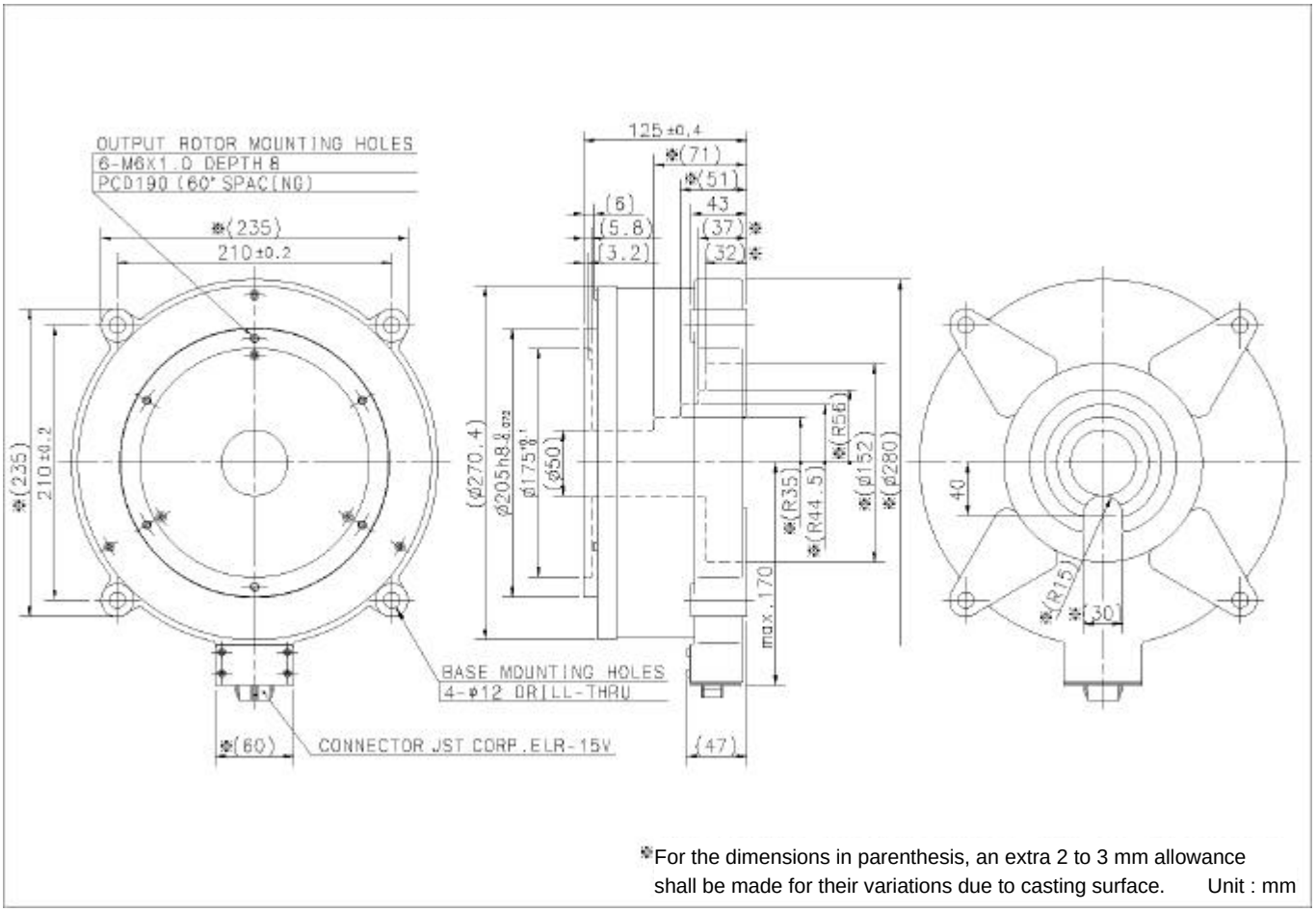
Figure 4-4 : M-YS3040GN501



※For the dimensions in parenthesis, an extra 2 to 3 mm allowance shall be made for their variations due to casting surface. Unit : mm

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

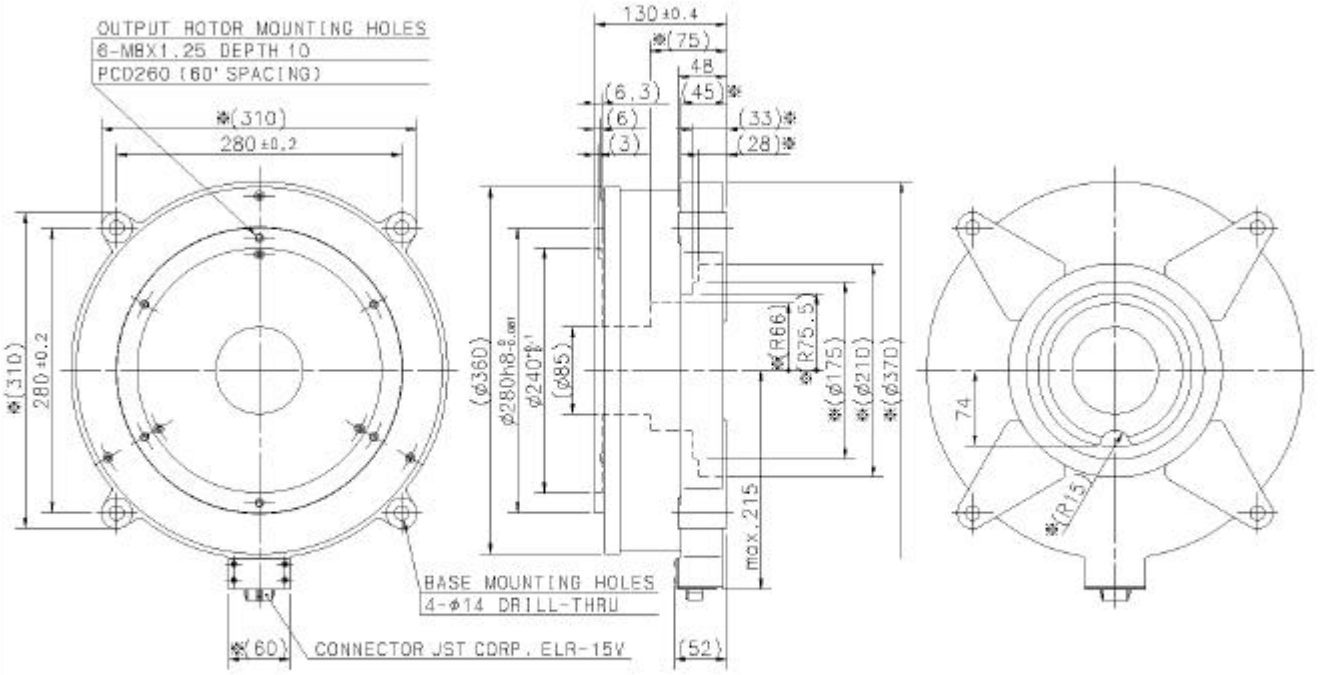
Figure 4-5 : M-YS4080GN001



※For the dimensions in parenthesis, an extra 2 to 3 mm allowance shall be made for their variations due to casting surface. Unit : mm

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

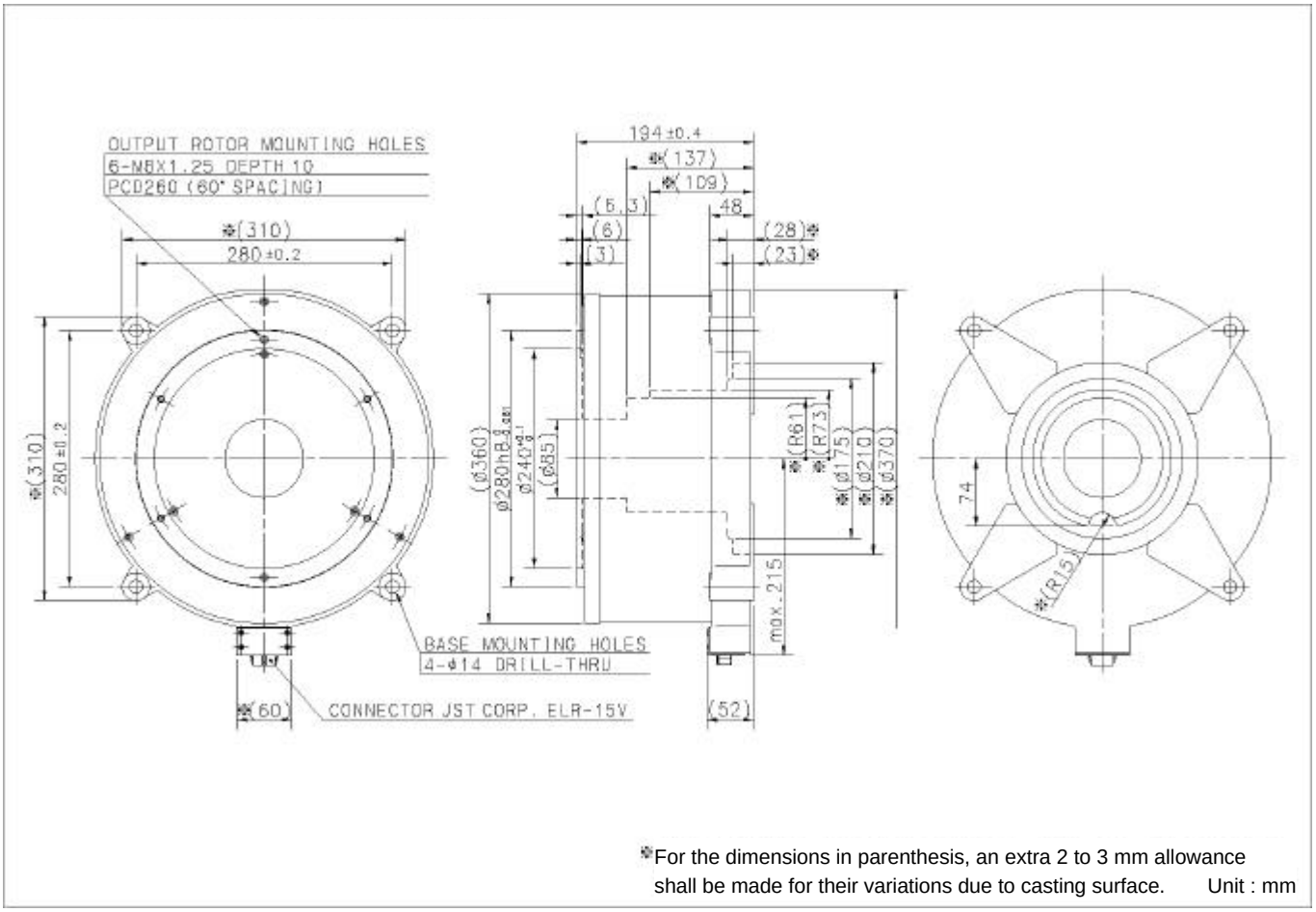
Figure 4-6 : M-YS5120GN001



※For the dimensions in parenthesis, an extra 2 to 3 mm allowance shall be made for their variations due to casting surface. Unit : mm

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Figure 4-7 : M-YS5240GN001

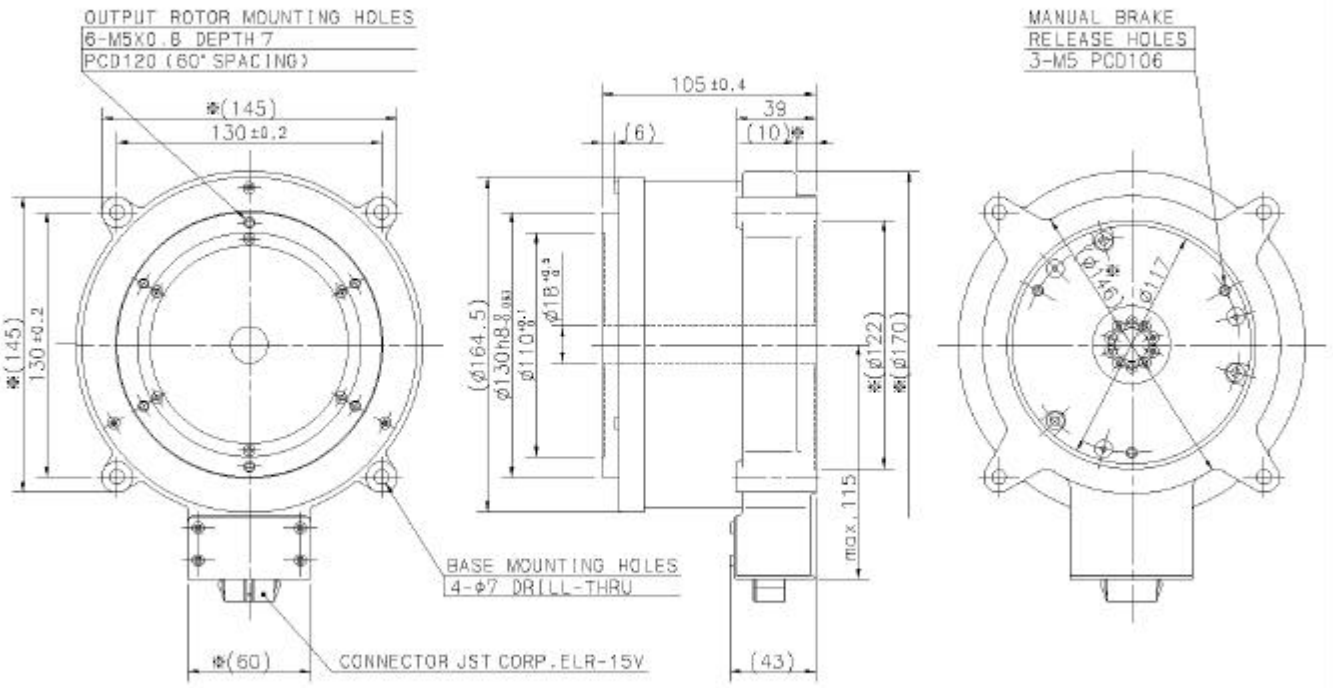


※For the dimensions in parenthesis, an extra 2 to 3 mm allowance shall be made for their variations due to casting surface. Unit : mm

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

2 Motor with brake

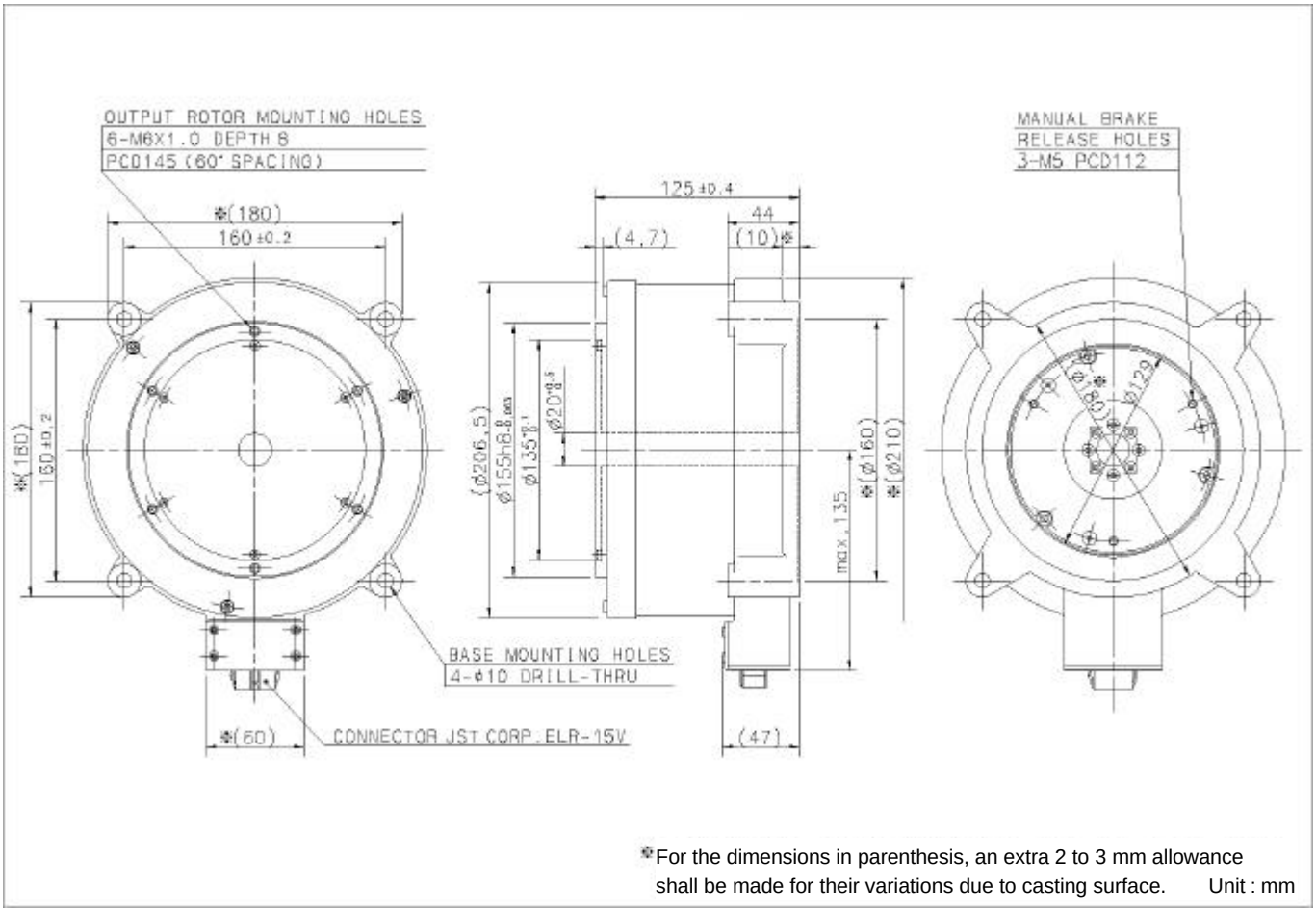
Figure 4-8 : M-YS2020GG001



*For the dimensions in parenthesis, an extra 2 to 3 mm allowance shall be made for their variations due to casting surface. Unit : mm

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

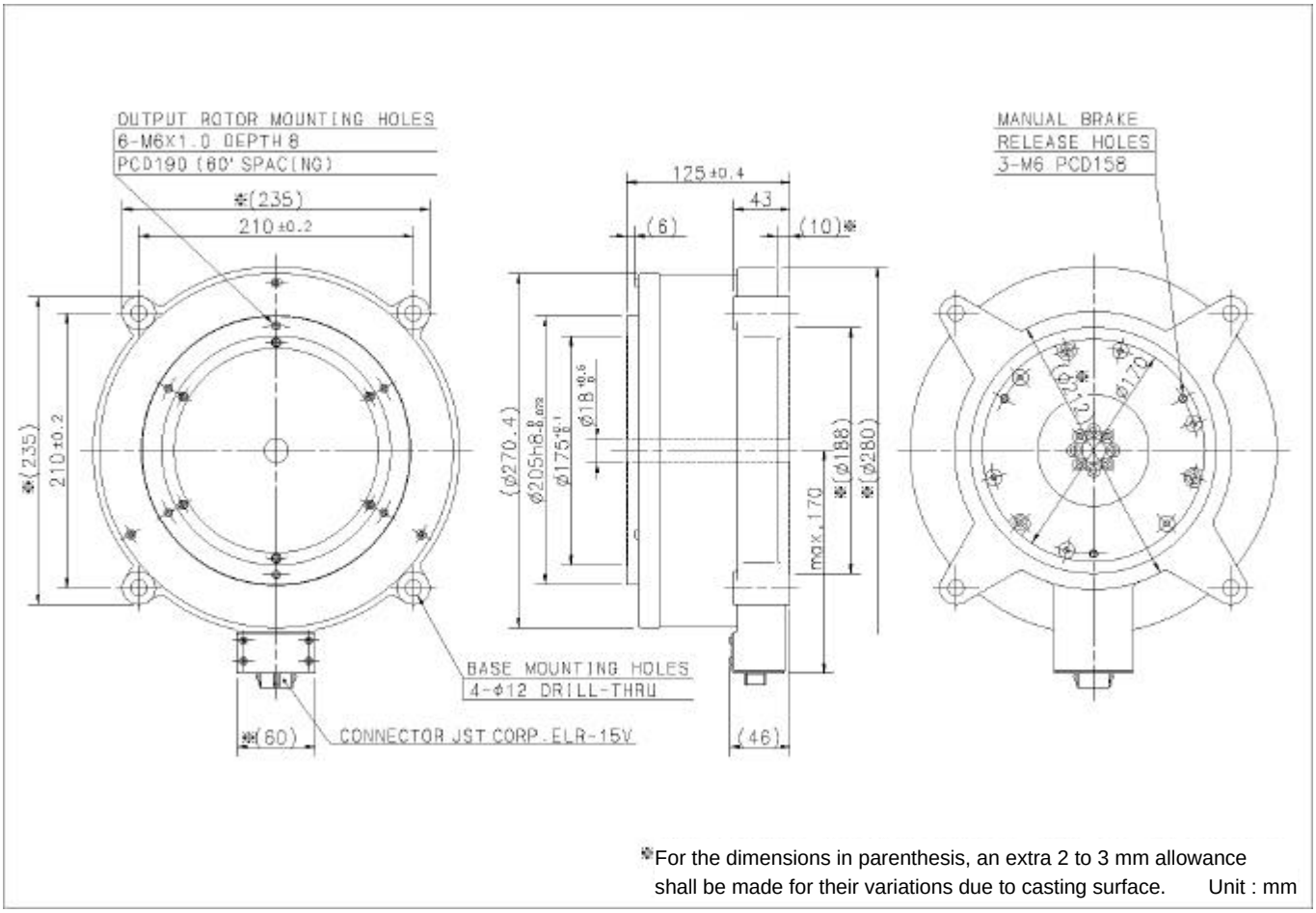
Figure 4-9 : M-YS3040GG001



*For the dimensions in parenthesis, an extra 2 to 3 mm allowance shall be made for their variations due to casting surface. Unit : mm

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

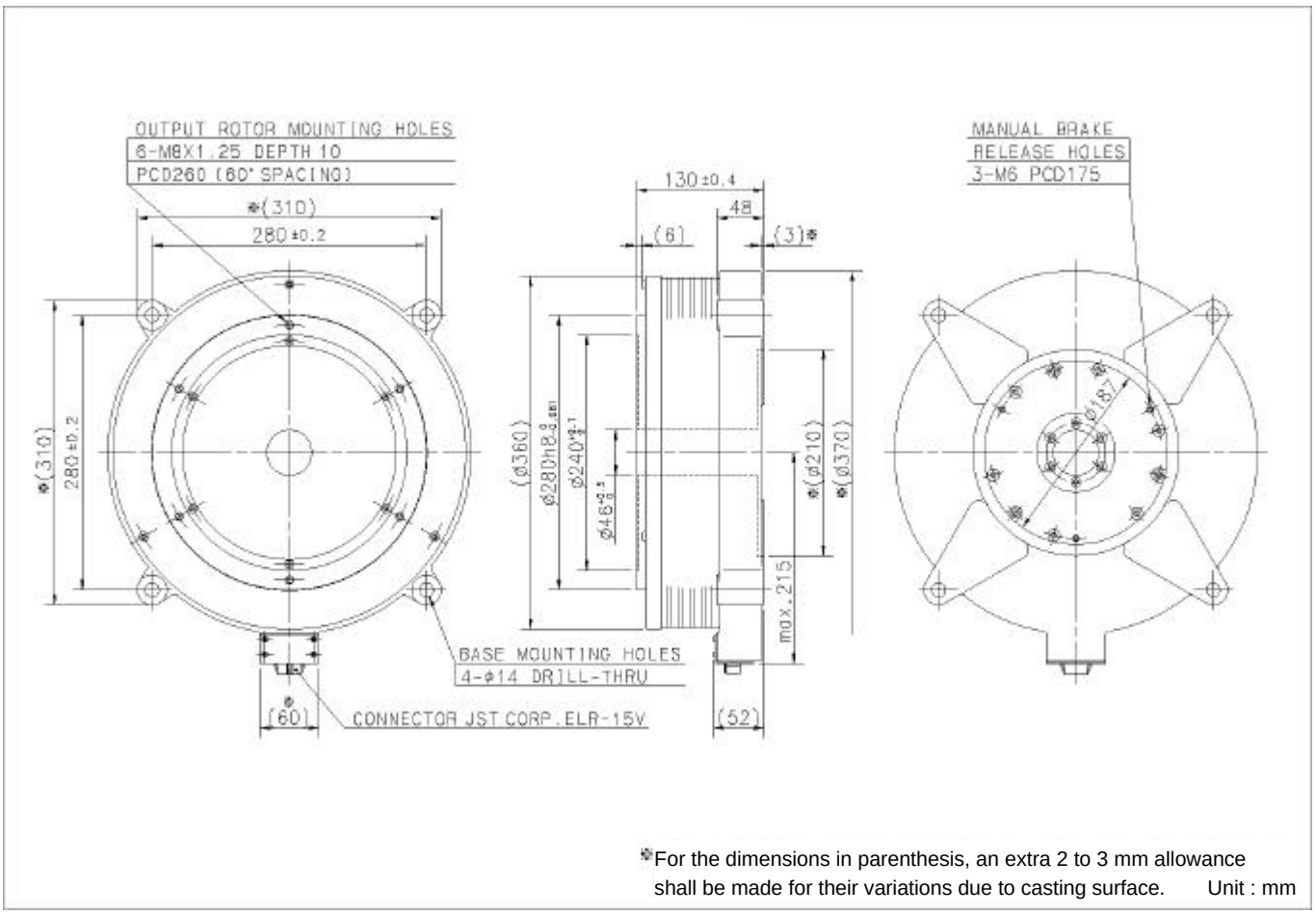
Figure 4-10 : M-YS4080GG001



※For the dimensions in parenthesis, an extra 2 to 3 mm allowance shall be made for their variations due to casting surface. Unit : mm

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Figure 4-11 : M-YS5120GG001

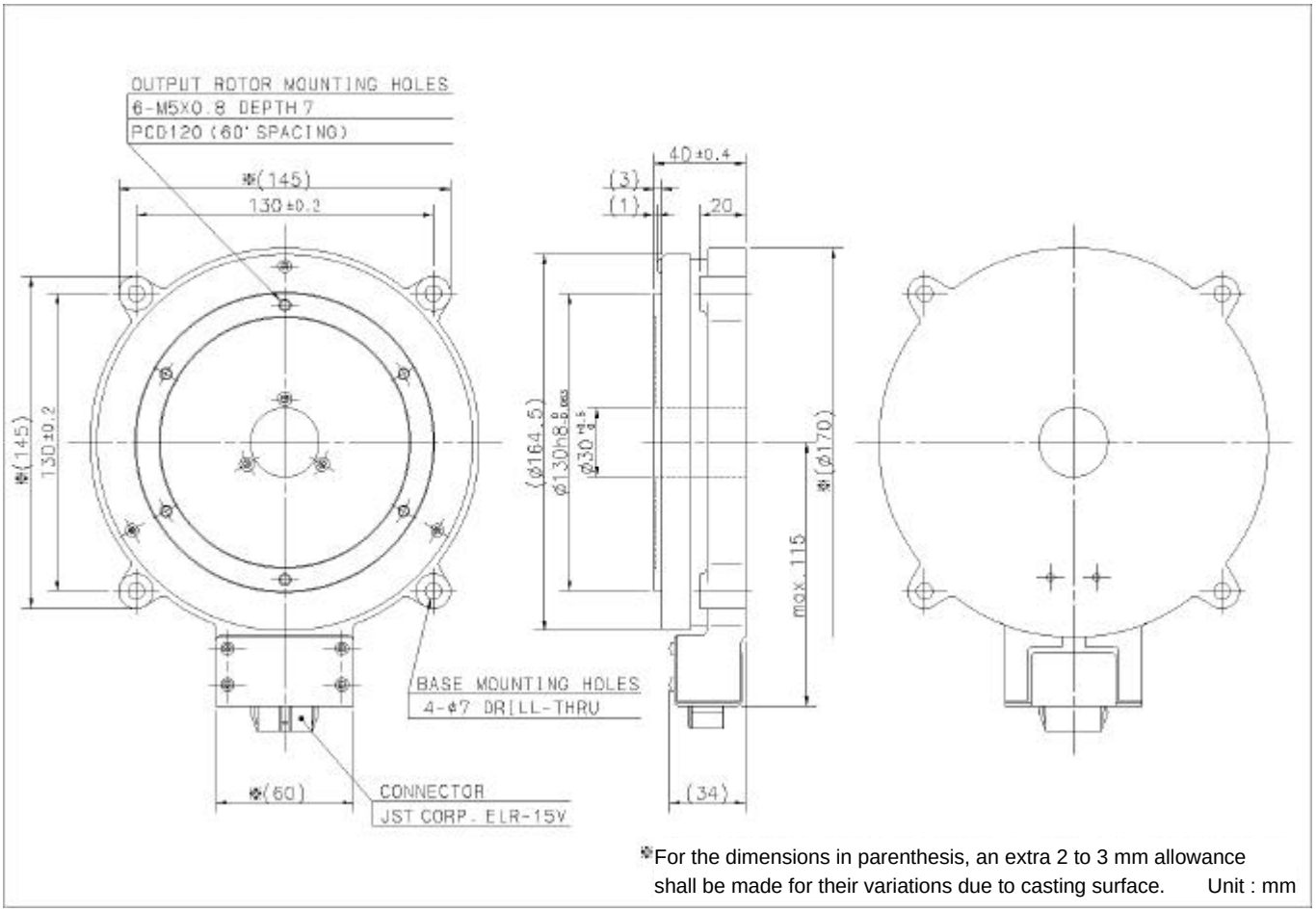


*For the dimensions in parenthesis, an extra 2 to 3 mm allowance shall be made for their variations due to casting surface. Unit : mm

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3 Low profile type

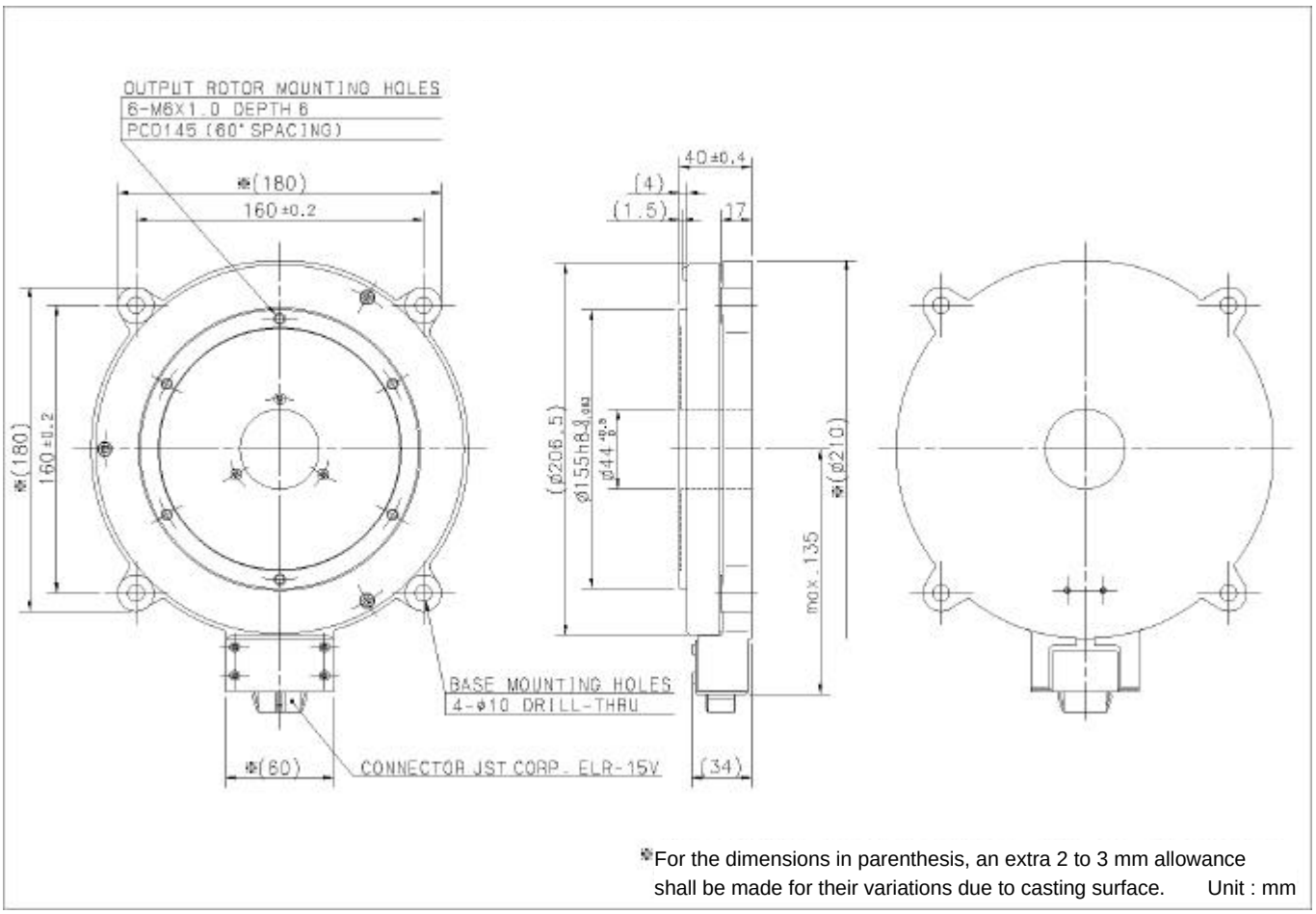
Figure 4-12 : M-YS2005GN001



*For the dimensions in parenthesis, an extra 2 to 3 mm allowance shall be made for their variations due to casting surface. Unit : mm

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Figure 4-13 : M-YS3008GN001



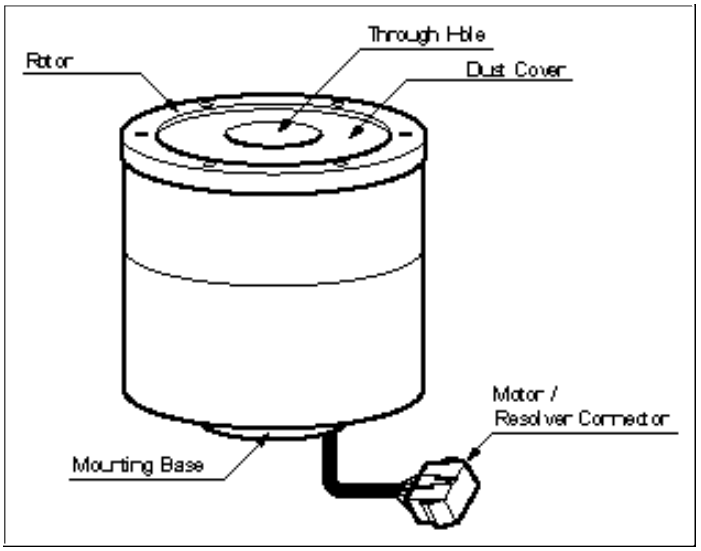
※For the dimensions in parenthesis, an extra 2 to 3 mm allowance shall be made for their variations due to casting surface. Unit : mm

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

4.1.2. JS Series Motor

4.1.2.1. Name of Parts

Figure 4-14



4.1.2.2. Specifications

- JS series Motor can be run on either 100V/110V or 200V/220V AC.

Table 4-4 : Specification

Item (unit) \ Motor reference No.		M-JS0002GN510	M-JS1003GN510	M-JS2006GN510	M-JS2014GN510
Motor outside diameter	(mm)	75	100	130	
Maximum torque	(N·m)	2	3	6	14
Maximum current/phase	(A)	1.5	1.5	3	
Allowable axial load	(N)	950	1960	3700	
Allowable moment load	(N·m)	10	40	60	
Axial rigidity Note (1)	(mm/N)	1.6×10^{-5}	1.4×10^{-5}	7.4×10^{-6}	
Moment rigidity Note (1)	(rad/N·m)	2.8×10^{-5}	1.4×10^{-5}	4.8×10^{-6}	
Maximum stall torque	(N·m)	1.4	2.1	4.2	9.8
Rotor moment of inertia	($kg \cdot m^2$)	0.002	0.004	0.005	0.010
Mass	(kg)	2.4	3.2	4.8	5.5
Operating conditions		IP40 Note (3)	IP40	IP40	IP40
		Temperature: 0~40°C, Humidity: 20~80% , Use indoors, free from dust, condensation and corrosive gases.			
Maximum speed	[s^{-1}(rps)]	4.5	3		
Resolution	(pulse/r)	409600	614400		
Positioning accuracy Note (2)	(sec)	300	150		
Repeatability	(sec)	±3.2	±2.1		
Compatible Driver Unit	AC200V	M-ESAJ0002T25	M-ESA-J1003T25	MESA-J2006T25	M-ESA-J2014T25
	AC100V	M-ESAJ0002V25	M-ESA-J1003V25	MESA-J2006V25	M-ESA-J2014V25

Note : (1) These value assume that the Motor is mounted on a rigid base.
(2) When used with an ESA25 Driver Unit (interchangeable).
(3) Internal Protection Level.

SI unit system
1N = 0.102 kgf = 0.225lb
1N·m = 0.102 kgf·m = 0.738 ft·lb

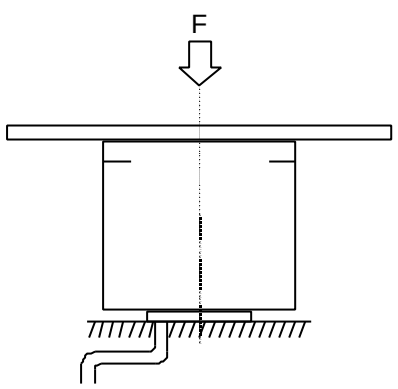
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

◆ How to calculate axial and moment load

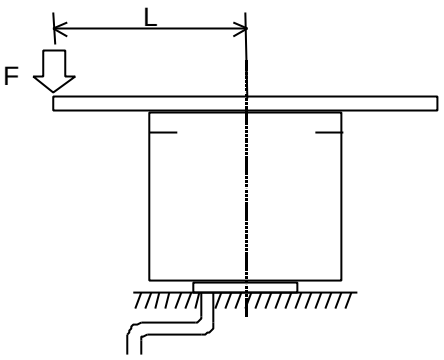
Caution : • *Do not apply excessive load to the Motor.*
An excessive load more than specified in Table 4-2 may result in premature Motor failure.

• *Followings show how to calculate the loads.*

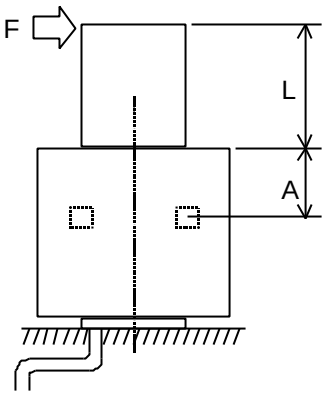
Figure 4-15



If F is an external force, then
- Axial load Fa = F + weight of payload
- Moment load M = 0



If F is an external force, then
- Axial load Fa = F + weight of payload
- Moment load M = F × L



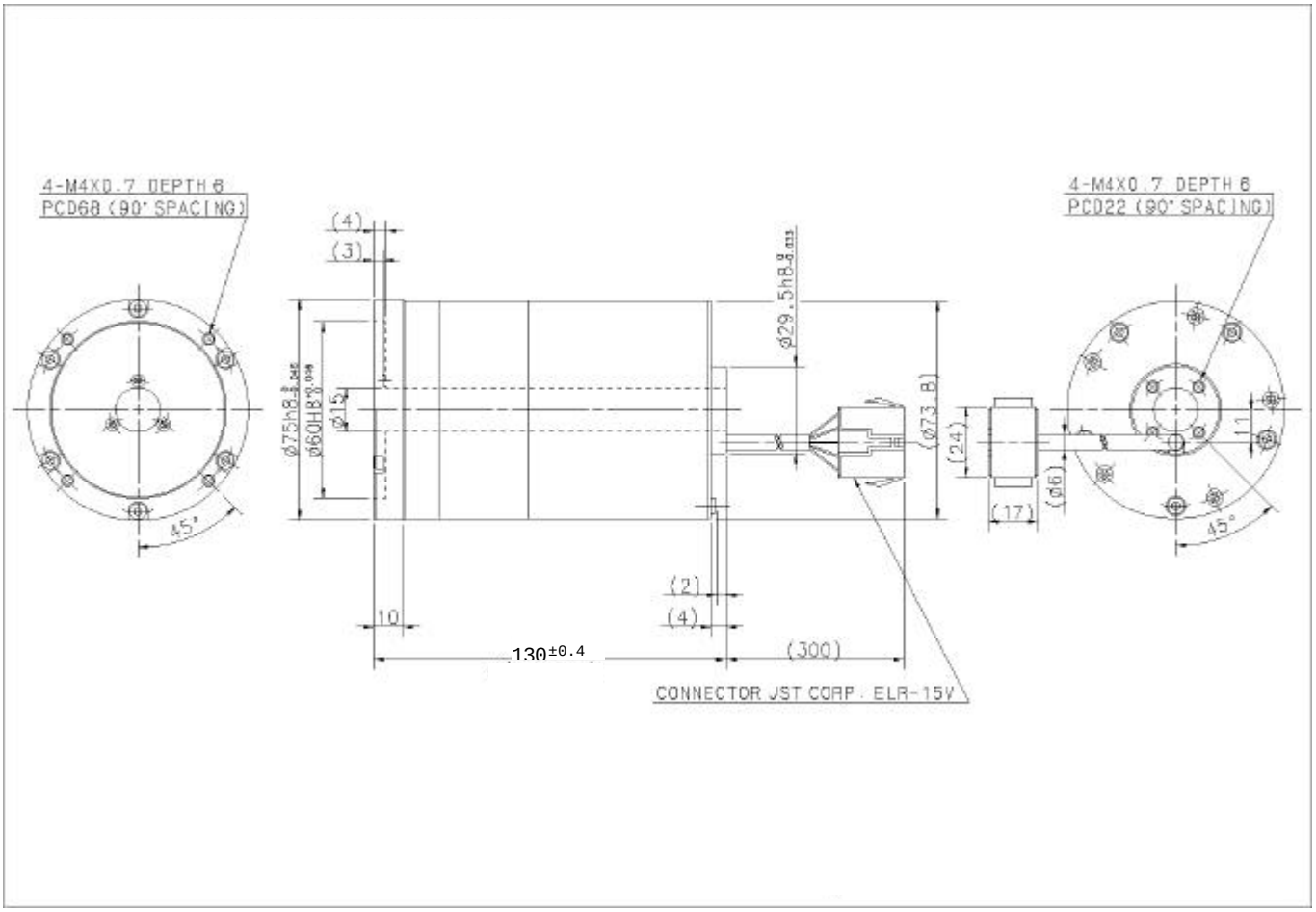
If F is an external force, then
- Axial load Fa = weight of payload
- Moment load M = F × (L+A)

Motor reference number	JS0002FN510	JS1003FN510	JS2006FN510	YS2014FN510
Dimension A (mm)	31	32	30	30

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

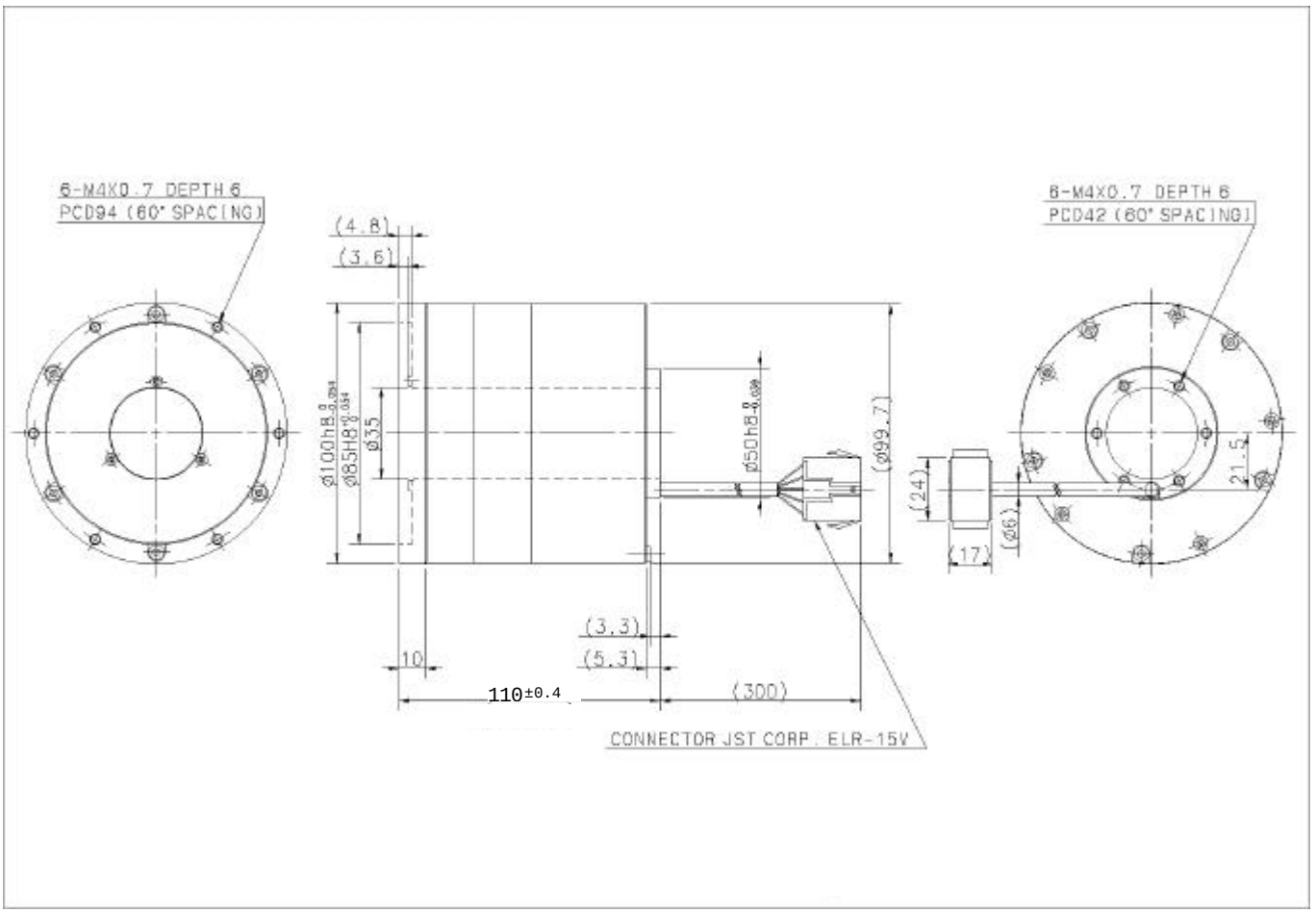
4.1.2.3. Dimensions

Figure 4-16 : M-JS0002GN510



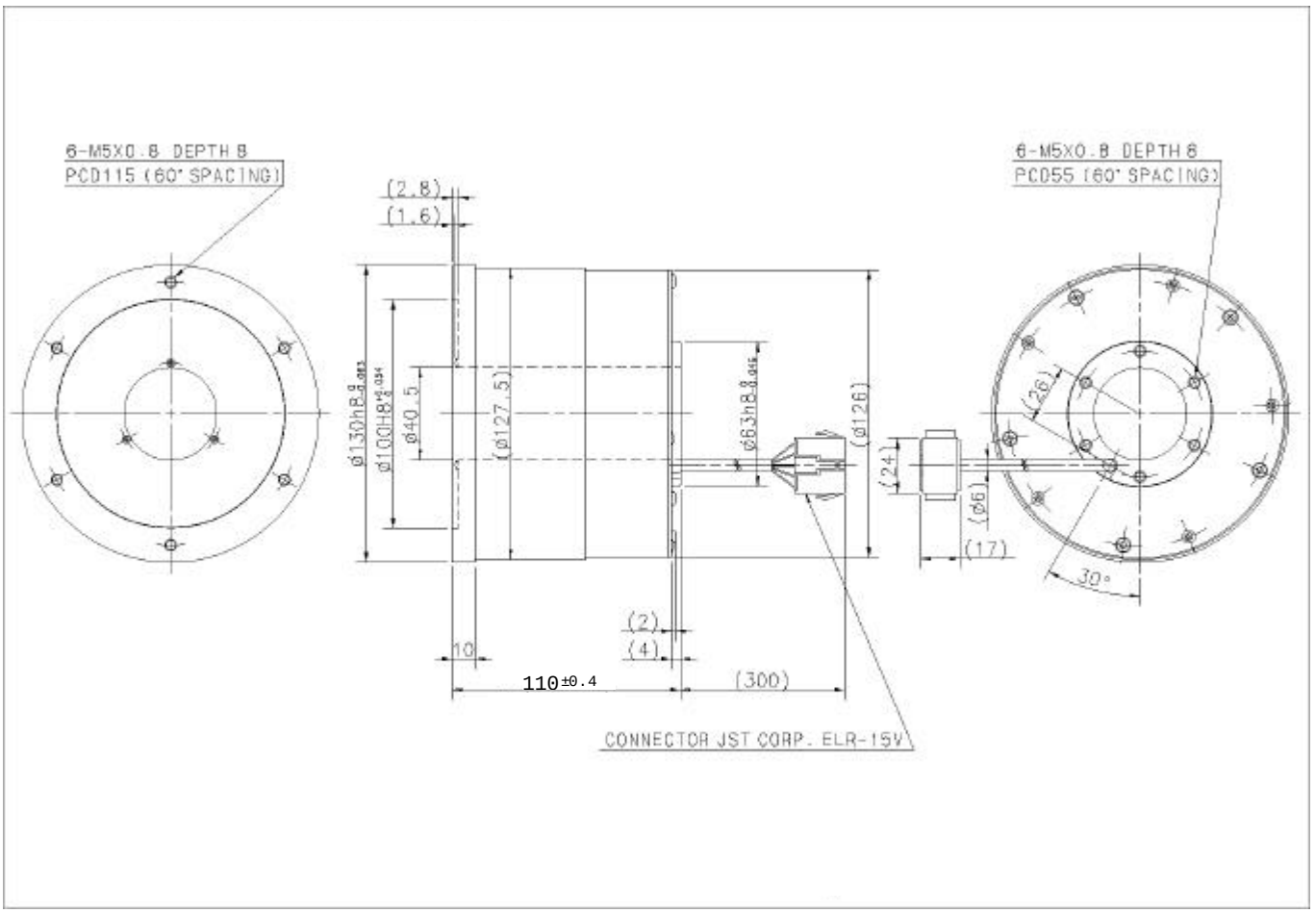
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Figure 4-17 : M-JS1003GN510



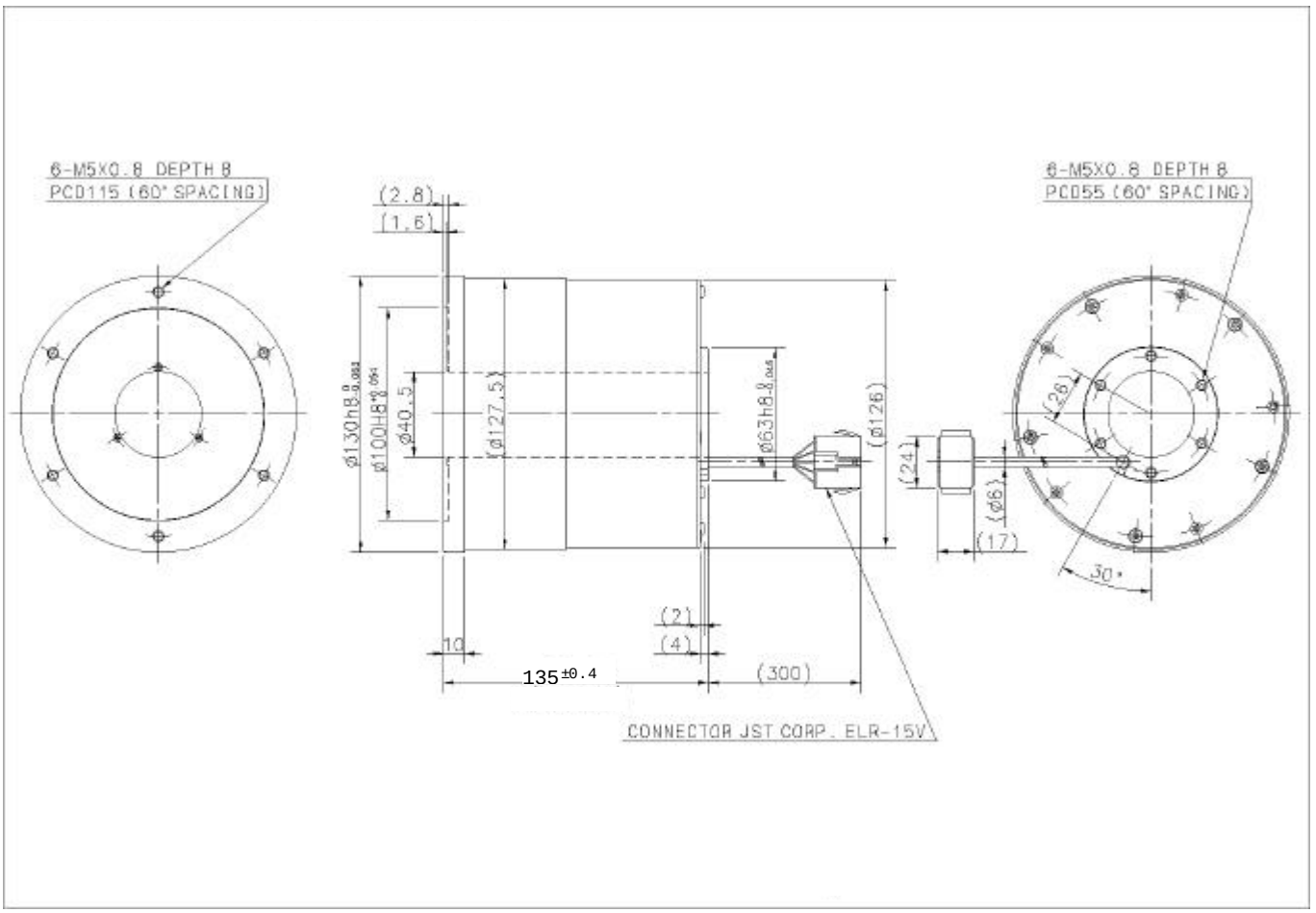
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Figure 4-18 : M-JS2006GN510



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Figure 4-19 : M-JS2014GN510

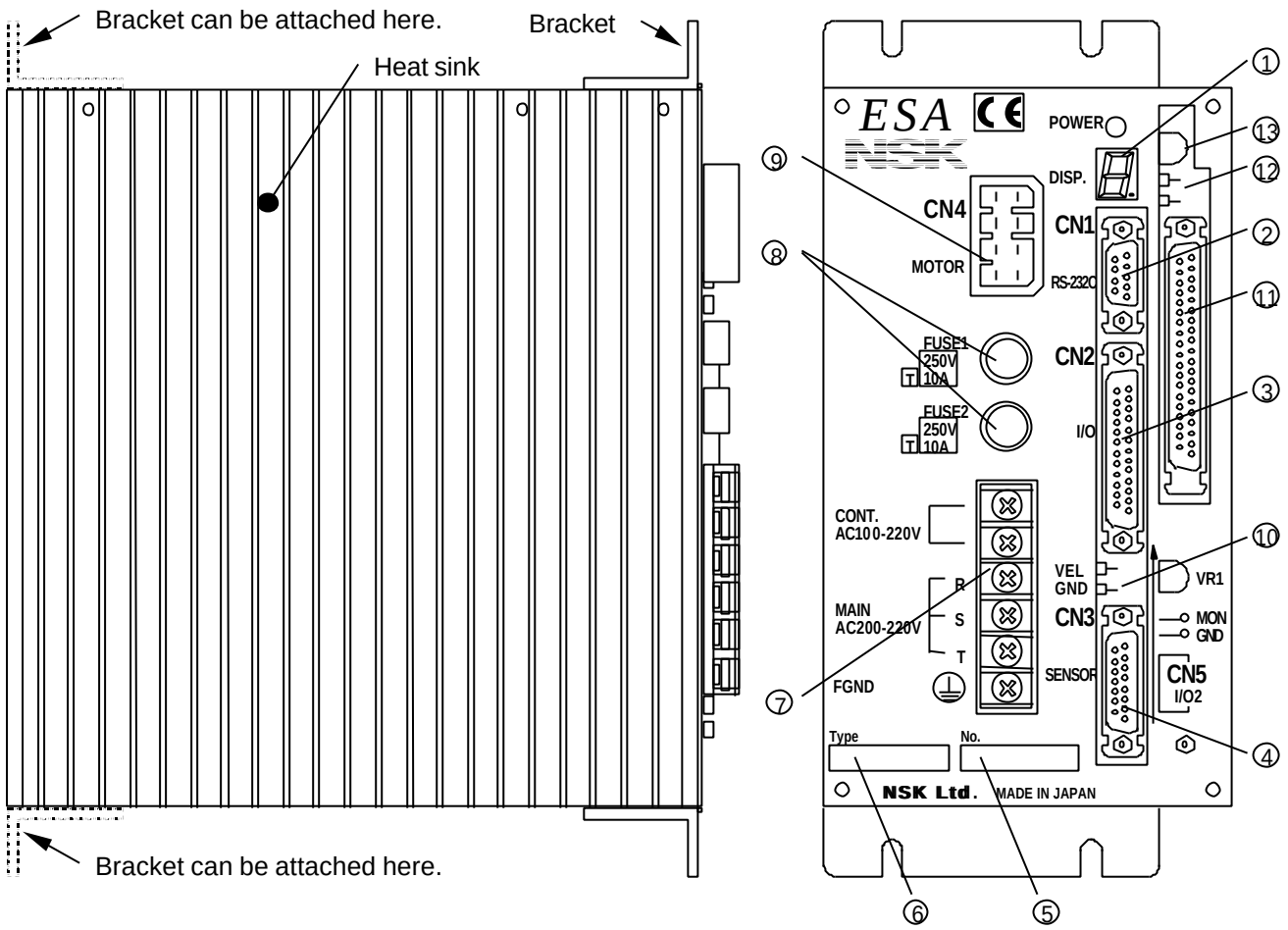


Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

4.2. Driver Unit

4.2.1. Name of Parts

Figure 4-20



① **7 segments LED**		⑦ **TB**	: Terminal Block, power supply
② **CN1 (9 pins)**	: RS-232C serial communication connector Connector for Handy Terminal FHT11	⑧ **Fuse 1 and 2**	: Fuse holder
		⑨ **CN4**	: Motor cable connector
		⑩ **Monitor pins**	: Analog velocity monitor pins
③ **CN2 (25 pins)**	: Motor control signal Input / Output	⑪ **CN5 (37 pins)**	: Motor control Input / Output connector (I/O2)
④ **CN3 (15 pins)**	: Resolver cable connector	⑫ **Monitor pins**	
⑤ **No.**	: Serial number plate	⑬ **VR1**	: Offset adjusting pod of analog input
⑥ **Type.**	: Reference number plate		

Caution : Use a time delay type and capacity of 250V T10A fuse for Fuse1 and Fuse2 on the front panel. Be sure to turn off the main power when replacing the fuse.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

4.2.2. General Specifications

◆ Control mode

- Closed loop, P·I position control

◆ Operation mode

- Pulse train position command
- RS-232C serial communication command
- Programmable control
- Return Home operation
- Jog

◆ Power supply capacity

1 AC200V/220V ±10%

Table 4-5 : Power supply capacity

Driver Unit Reference No.	Main power Max. (exclude surge current)	Control power Max. (exclude surge current)
M-ESA-Y2005T25	0.5 kVA	50 VA
M-ESA-Y2020T25	1.0 kVA	
M-ESA-Y3008T25	0.6 kVA	
M-ESA-Y3040T25	1.2 kVA	
M-ESA-Y4080T25	1.4 kVA	
M-ESA-Y5120T25	1.5 kVA	
M-ESA-Y5240T25	2 kVA	
M-ESA-J0002T25	0.7 kVA	
M-ESA-J1003T25	0.7 kVA	
M-ESA-J2006T25	0.9 kVA	
M-ESA-J2014T25	1.0 kVA	

* For the power supply capacity of RS and SS series motors, refer to their specification document.

Table 4-6 : Surge and leakage current

		Control power	Main power
Surge current		14A	140A
Leakage current	(40^{Hz} ~ 1^{kHz})	5 mA rms	
	(~ 1^{MHz})	35 mA rms	

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

2 AC100V/110V ±10 %

Table 4-7 : Power supply capacity

Driver Unit Reference No.	Main power Max. (exclude surge current)	Control power Max. (exclude surge current)
M-ESA-Y2005V25	0.3 kVA	50 VA
M-ESA-Y2020V25	0.7 kVA	
M-ESA-Y3008V25	0.3 kVA	
M-ESA-Y3040V25	0.9 kVA	
M-ESA-Y4080V25	1.0 kVA	
M-ESA-Y5120V25	1.0 kVA	
M-ESA-J0002V25	0.4 kVA	
M-ESA-J1003V25	0.4 kVA	
M-ESA-J2006V25	0.7 kVA	
M-ESA-J2014V25	0.7 kVA	

* For the power supply capacity of RS and SS series motors, refer to their specification document.

Table 4-8 : Surge and leakage current

		Control power	Main power
Surge current		7A	80A
Leakage current	(40^{Hz} ~ 1^{kHz})	3 mA rms	
	(~ 1^{MHz})	20 mA rms	

◆ Environmental specifications

Table 4-9

Vibration resistance		0.5G (Conform to JIS-C0911.)	
Line noise resistance		1500V 1μS (by noise simulator)	
Mass		3kg	
Environmental condition	In operation	Temperature: 0 ~ 50°C	Humidity: 20 ~ 90 % (no condensation)
	In storage	Temperature: - 20 ~ 70°C	Use indoors, free from dust, condensation and corrosive gases.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

4.2.3. Functional Specifications

◆ Control mode can be selected by the parameter SL.

- SL1 : Torque control mode
- SL2 : Velocity control mode
- SL3 : Position control mode

◆ Position control mode

- RS-232C serial communication command
- Programmable control (internal programmable indexer)
  - ◊ 64 channels
- Pulse train input operation
  - ◊ CW/CCW or
  - ◊ Pulses/direction or
  - ◊ Phase A • Phase B
- Jog operation
- Home Return operation

◆ Velocity control mode

- RS-232C serial communication
- Analog ±10V

◆ Torque control mode

- RS-232C serial communication
- Analog ±10V

◆ Position detector resolution (Resolver)

Table 4-10

Resolver resolution / Motor type	Automatic resolution switching or 12-bit setting	10-bit setting
YS, JS1, JS2, RS	614 400 pulse/r	153 600 pulse/r
SS	491 520 pulse/r	122 880 pulse/r
AS, BS, JS0	409 600 pulse/r	102 400 pulse/r

- 12-bit or 10-bit setting can be selected by RR parameter.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

◆ Maximum velocity

Table 4-11

Resolver resolution / Motor type	12-bit setting	Automatic resolution switching or 10-bit setting
YS, JS1, JS2, RS	1 s^{-1}	3 s^{-1}
SS	1.25 s^{-1}	3.75 s^{-1}
AS, BS, JS0	1.5 s^{-1}	4.5 s^{-1}

◆ Encoder output signal : øA , øB and øZ (MSB)

- Signal output format:
  - ◊ øA , øB : Line driver
  - ◊ øZ (MSB) : Line driver/ Open collector selectable (It can be switched by a jumper pin 1.)

Table 4-12 : Resolution

Resolver resolution / Motor type	øA, øB		øZ (MSB)
	12-bit setting	10-bit setting	
YS, JS1, JS2, RS	153 600 pulse/r	38 400 pulse/r	150 pulse/r
SS	122 880 pulse/r	30 720 pulse/r	120 pulse/r
AS, BS, JS0	102 400 pulse/r	25 600 pulse/r	100 pulse/r

◆ Control I/O signal

- Input signals : Emergency stop, Servo on, Home position limit, Run move, Programmable indexer channel switching (max. 64 channels) Jog and Overtravel limit
- Output signals : Driver Unit ready, In position and Brake[*1]

  *1 : The brake output signal is for controlling the brake. It cannot be used to supply power to an electromagnetic brake.

◆ Alarms

- Excess position error, Software thermal limit, Overtravel limit, Control circuit error, Resolver circuit error, Over current, Heat sink overheat, Main AC line under or over voltage and Control power under voltage.

◆ Monitor output

- Analog monitor, Analog velocity and RS-232C communication monitor
  - ◊ Current position, Alarm state, Servo parameters, etc.

◆ Communication

- Asynchronous RS-232C communication Baud rate: 9600 b.p.s.

◆ Data back up

- Backed up by EEPROM
- 500 000 times for resetting/ deleting parameters

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

4.2.4. Jumper

- Jumper (JP1) is for selecting output format of øZ position feedback signal.
- Jumper is inside of the Driver Unit. When setting Jumper, remove the side cover of the Driver Unit. Follow the procedure in Appendix 4 : How to Replace ESA25 Driver Unit.
- Figure 4-14 indicates the Jumper location.

Figure 4-21

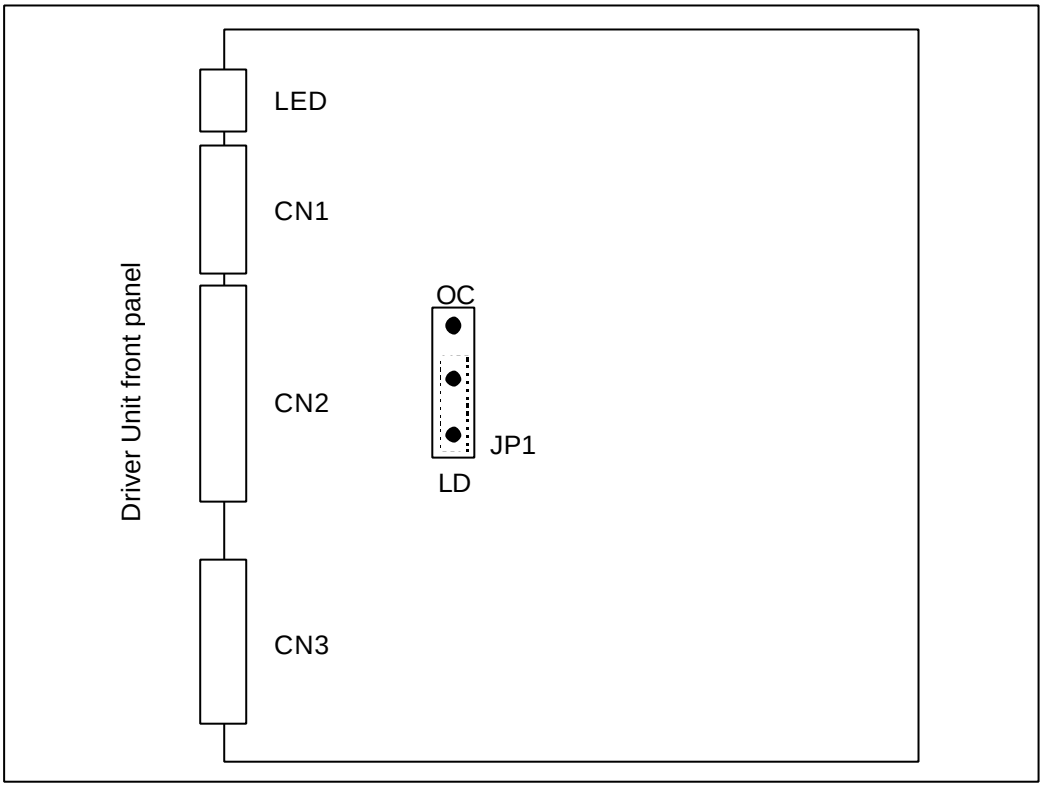


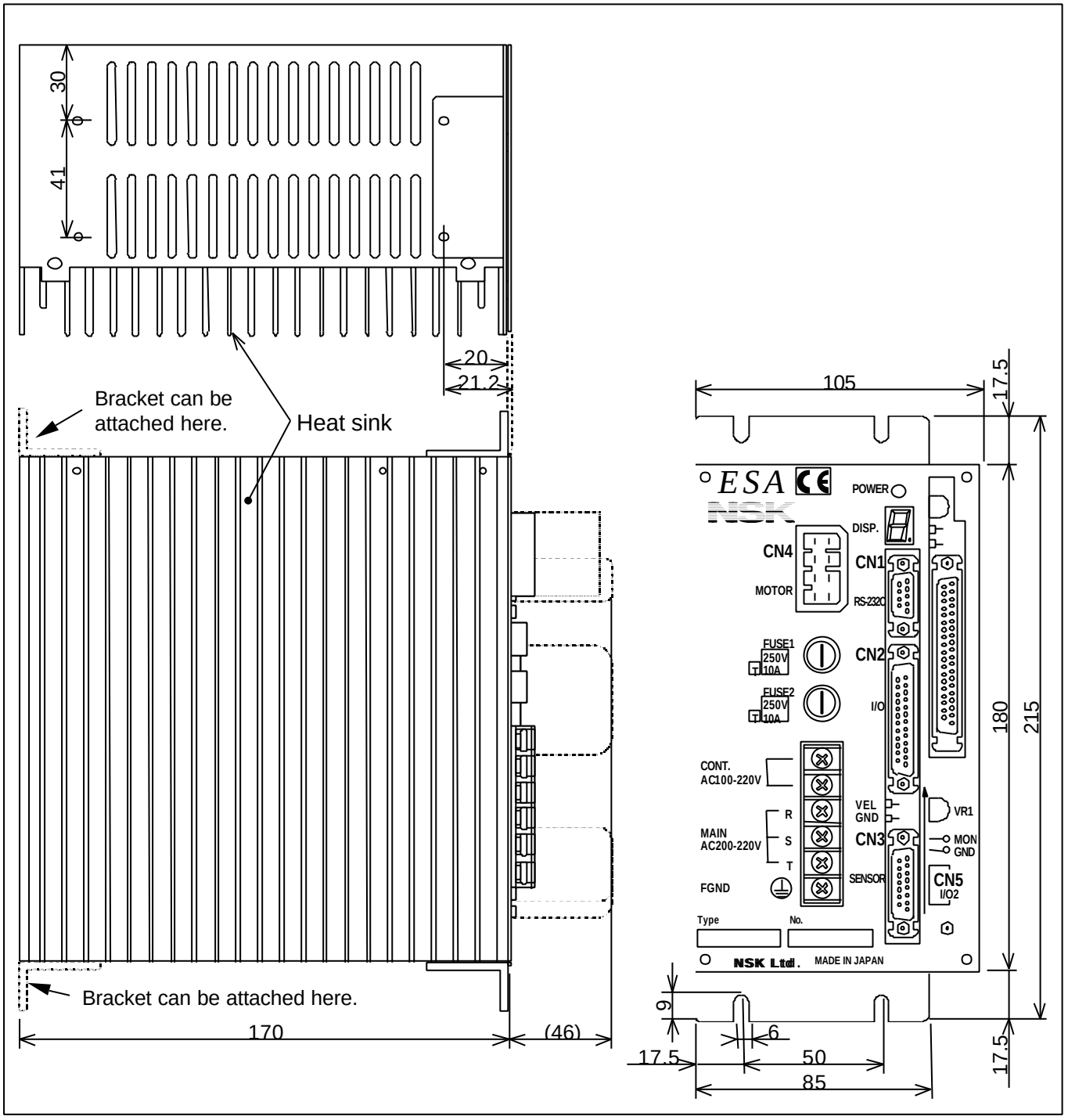
Table 4-13 : Jumper setting.

Setting	øZ output format
LD-Out short	Line driver (Shipping set)
OC-Out short	Open collector

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

4.2.5. Dimensions

Figure 4-22



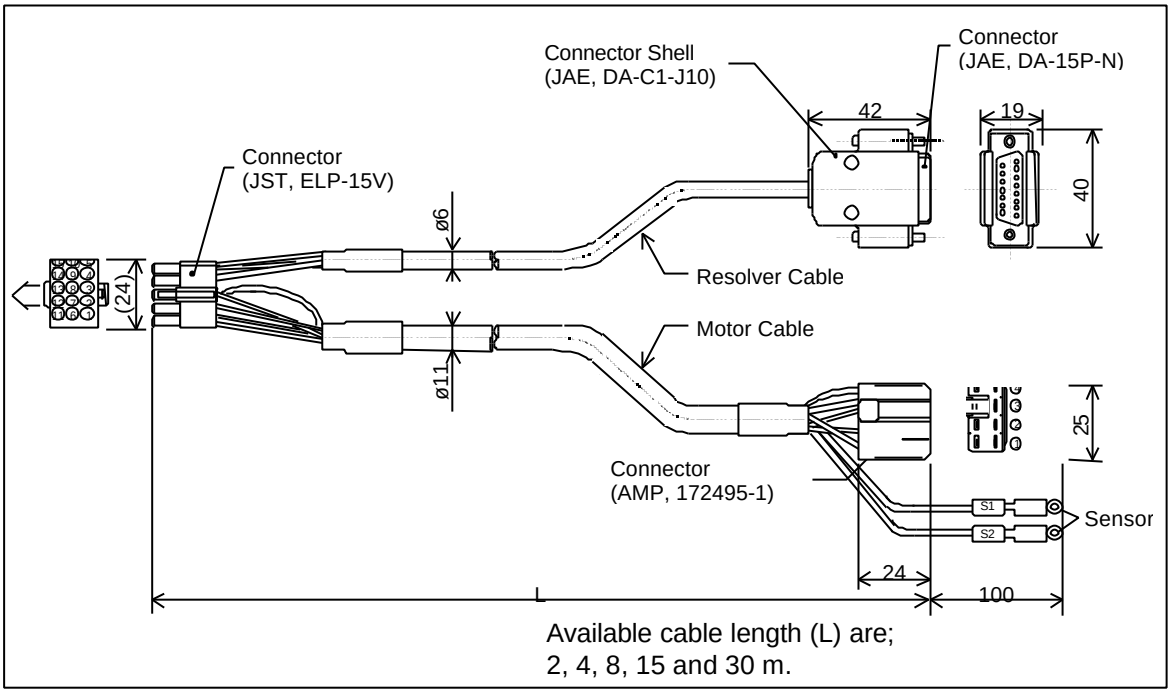
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

4.3. Cable Set

- This section shows Cable Set for YS and JS series Motor.
- Refer to respective specification for SS, AS and RS series Motor.
- For reference number and cable length, see “3.3. Standard Combination.”

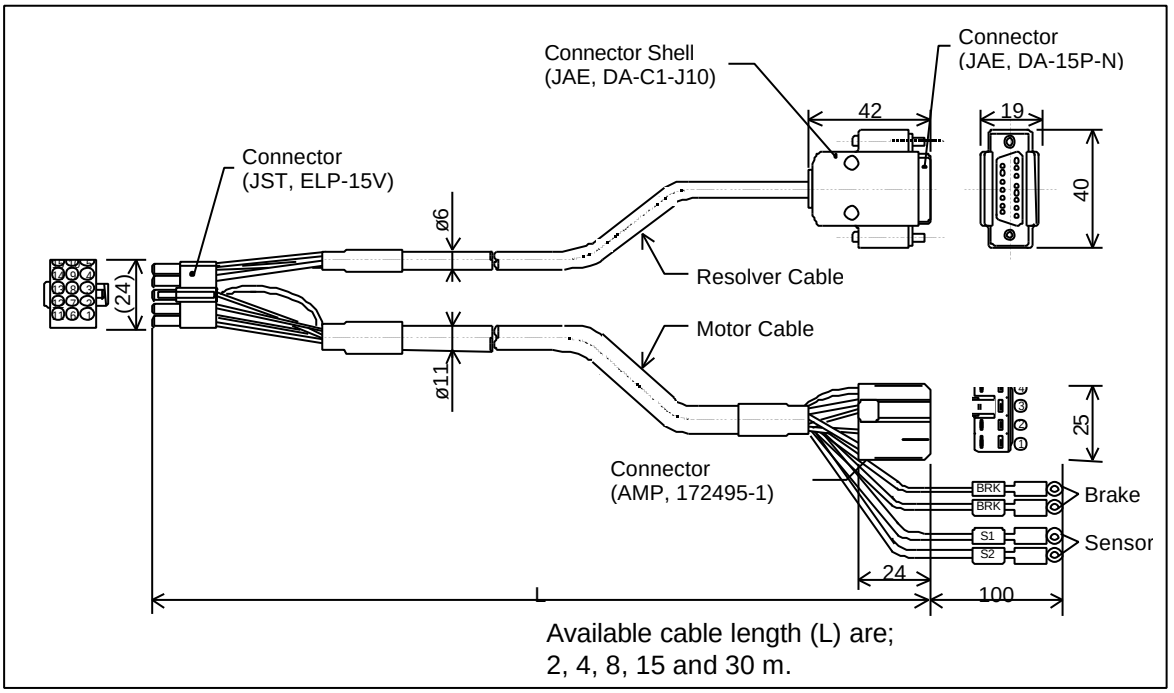
4.3.1. Cable Set for YS Motor and JS Motor

Figure 4-23



4.3.2. Cable Set for YS Motor with Brake

Figure 4-24



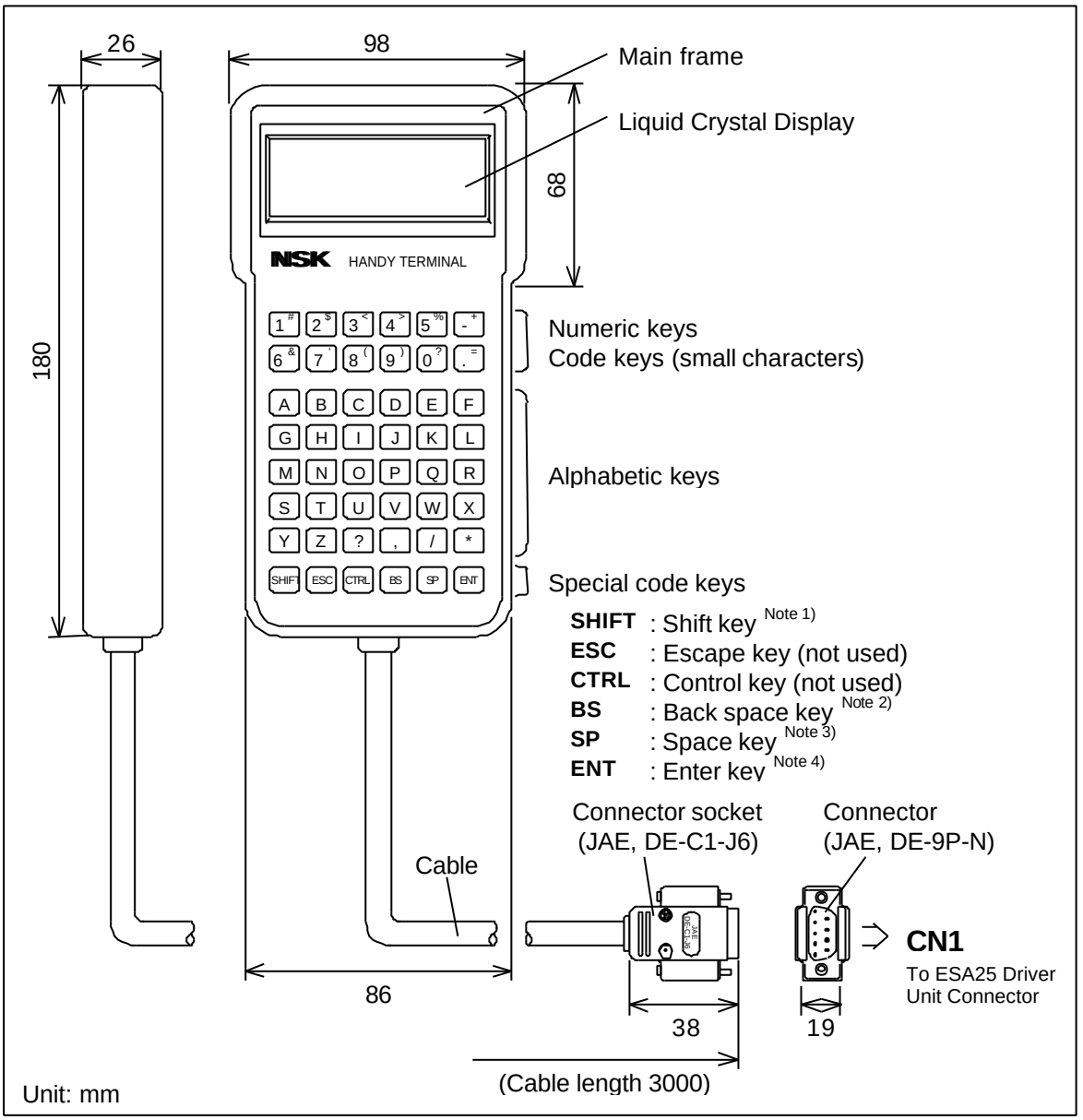
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

4.4. Handy Terminal

- FHT11 Handy Terminal is an easy to use hand held terminal with an RS-232C communication interface for Megatorque Motor System Driver Unit. FHT11 terminal connects directly to the CN1 connector on the ESA25 Driver Unit.

4.4.1. Name of Parts and Dimensions

Figure 4-25



Note : 1) SHIFT : Press the code key while holding [SHIFT] key. (Small characters)

2) BS : When correcting logged-in mistakes, press [BS] key.

3) SP : Press [SP] key to put a space between characters

4) ENT : Press [ENT] key at the end of the command or the parameter setting.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

4.4.2. Specification

Table 4-14

Item	Specification	
Power source valtage	DC 5V ±5%	
Power consumption	200 mW	
Environment	Temperature	• Operating : 0~50℃ • Storage : -10~+65℃
	Humidity	35~85% (Non condensing)
RS-232C Interface	Data code	ASCII code
	Communication speed	9600 b.p.s
	Data bit	8 bit
	Stop bit	2 bit
	Start bit	1 bit
	Parity check	None
Mass	250g (exclude cable)	

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

5. Connector Specifications

5.1. CN1 : RS-232C Serial Communication Connector

- NSK's Handy Terminal FHT11 (sold separately) can be used as an RS-232C terminal.

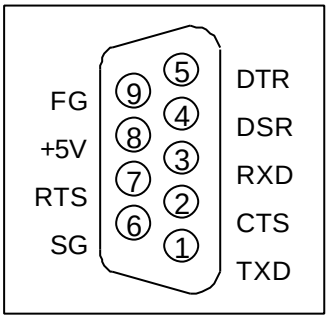
Table 5-1

Driver Unit connector	Japan Aviation Electronics Industry, Ltd.	DELC-J9SAF-13L9
Mating connector type (user device side)	Japan Aviation Electronics Industry, Ltd. (to be prepared by the user)*	DE-9PF-N
Mating connector shell type (user device side)	Japan Aviation Electronics Industry, Ltd. (to be prepared by the user)*	DE-C2-J6

* These connectors are not necessary if NSK Handy Terminal FHT11 is used.

5.1.1. CN1 Pin-Out

Figure 5-1 : CN1 Pin-out



5.1.2. CN1 Signal List

Table 5-2 : CN1 Signal List

Pin	Signal Name	I/O	Function
1	TXD	Output	Transmit data
2	CTS	Input	Clear to send
3	RXD	Input	Receive data
4	DSR	Input	Data set ready
5	DTR	Output	Data terminal ready
6	SG	–	Digital signal ground
7	RTS	Output	Ready to send
8	+5V	Output	Never connect
9	FG	–	Frame ground (shield)

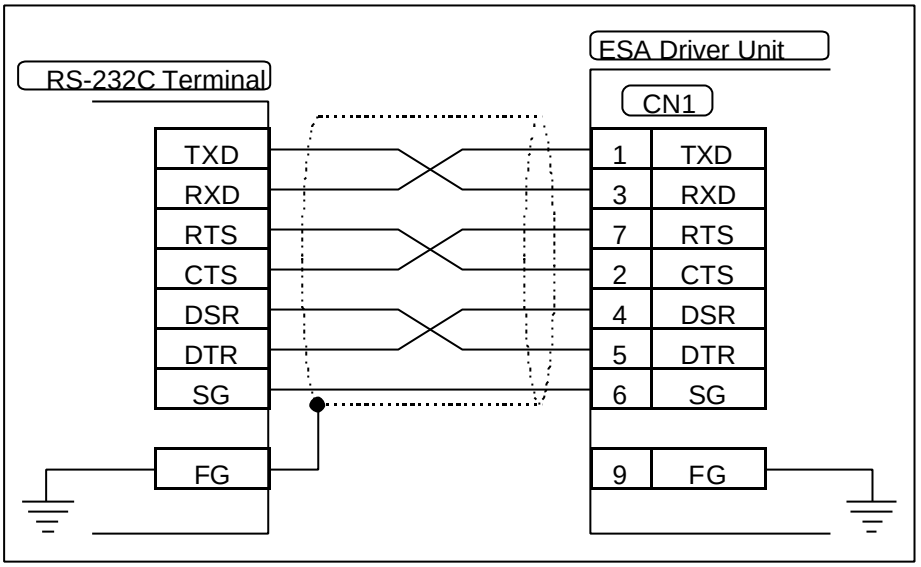
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

5.1.3. Sample Wiring Diagram

- Connect the ESA25 Driver Unit with the controller (e.g., personal computer) in accordance with its RS-232C control signal specification.

◆ RTS Control / CTS Monitoring Active (standard wiring)

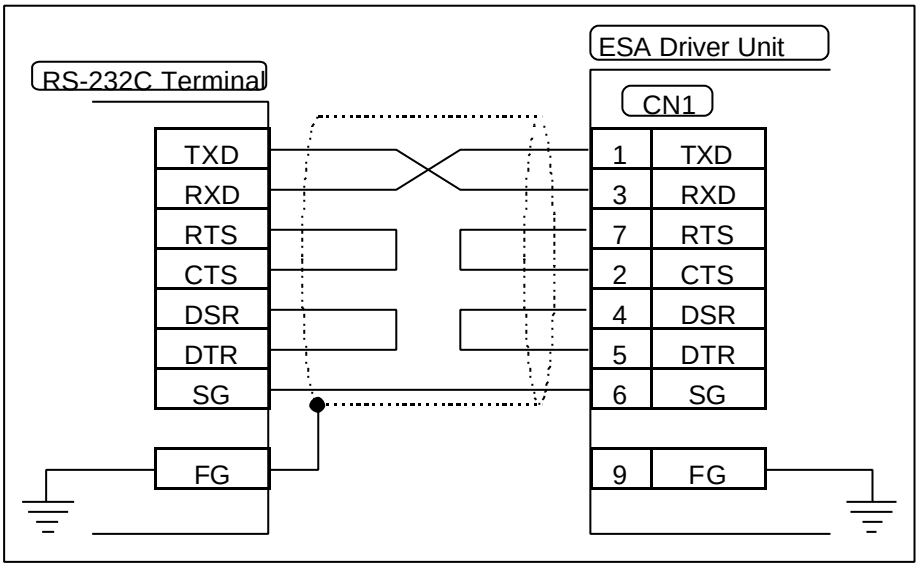
Figure 5-2



◆ RTS Control / CTS Monitoring Inactive

Important : When wired as shown below, always confirm the echo-back from the Driver Unit or send the data slowly. With this wiring, the Driver Unit may not accept the whole data when they are sent at high speed and in large amount.

Figure 5-3



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

5.2. CN2,CN5 : Control I/O Signal Connectors

- Table 5-3 shows connector types of CN2 and CN5.

Table 5-3

Driver Unit side connector	CN2	Japan Aviation Electronics Industry, Ltd.	DBLC-J25SAF-13L9
	CN5		DCLC-J37SAF-13L9
Mating connector (user device side)	CN2	Japan Aviation Electronics Industry, Ltd.	DB-25PF-N *1
	CN5		DC-37PF-N *1
Mating connector shell type (user device side)	CN2	Japan Aviation Electronics Industry, Ltd.	DB-C2-J9 *1
	CN5		DC-C8-J13-F4-1 *1

* 1: Provided with Driver Unit

- Wiring precautions for CN2 and CN5 connectors are described below.

1) Use shielded cable for CN2 and CN5 wiring.

2) Twisted cables must be used for the pulse train input and position feed back signals.

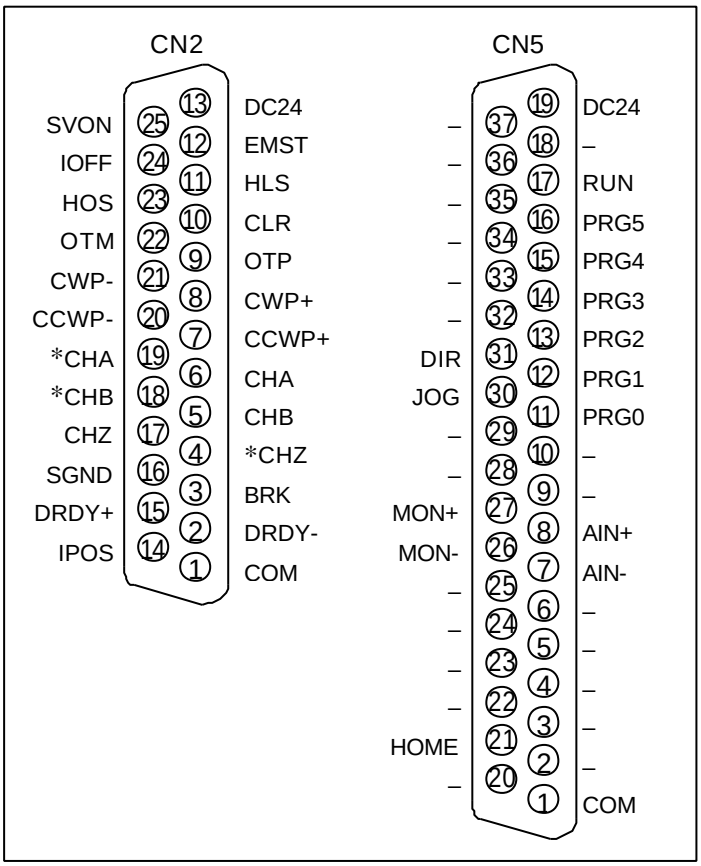
3) These cables should be laid sepalately from the power line. Wiring length shall be short as possible.

4) Connect one end of shield to the frame ground. Refer to "6.4.2. Ground Connection and Wiring."

Caution : *Check for wiring mistake of external power supply polarity and shorting between connector pins.*

5.2.1. Pin- Out (CN2, CN5)

Figure 5-4



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

5.2.2. Signal Name and Function (CN2, CN5)

Table 5-4 : CN2

Pin	Signal Name	I/O	Function
1	COM	Output	Output COMMON
2	DRDY-	Output	Driver Unit ready (-)
3	BRK	Output	Brake control signal (normally close)
4	∗CHZ	Output	Position feedback øZ/digital position data ∗MSB*
5	CHB	Output	Position feedback øB
6	CHA	Output	Position feedback øA
7	CCWP+	Input	Counter clockwise pulse (+)
8	CWP+	Input	Clockwise pulse (+)
9	OTP	Input	+ direction overtravel limit switch (CW direction)
10	CLR	Input	Clear
11	HLS	Input	Home limit switch
12	EMST	Input	Emergency stop
13	DC24	Input	24 VDC external supply
14	IPOS	Output	In position
15	DRDY+	Output	Driver Unit ready (+)
16	SGND	–	Signal ground
17	CHZ	Output	Position feedback øZ /digital position data MSB*
18	∗CHB	Output	Position feedback ∗øB*
19	∗CHA	Output	Position feedback ∗øA*
20	CCWP-	Input	Counter clockwise pulse (-)
21	CWP-	Input	Clockwise pulse (-)
22	OTM	Input	- direction overtravel limit switch (CCW direction)
23	HOS	Input	Home return start
24	IOFF	Input	Integration off
25	SVON	Input	Servo-on

* The parameter FZ (RS-232C communication interface) is used to select the position feedback signal øZ or the digital position signal ∗MSB.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Table 5-5 : CN5

Pin	Signal Name	I/O	Function
1	COM	Output	Output COMMON
2	–	–	Do not connect
3	–	–	Do not connect
4	–	–	Do not connect
5	–	–	Do not connect
6	–	–	Do not connect
7	AIN-	Input	Analog command (-)
8	AIN+	Input	Analog command (+)
9	–	–	Do not connect
10	–	–	Do not connect
11	PRG0	Input	Internal program channel selection bit 0
12	PRG1	Input	Internal program channel selection bit 1
13	PRG2	Input	Internal program channel selection bit 2
14	PRG3	Input	Internal program channel selection bit 3
15	PRG4	Input	Internal program channel selection bit 4
16	PRG5	Input	Internal program channel selection bit 5
17	RUN	Input	Start internally programmed operation
18	–	–	Do not connect
19	DC24	Input	DC 24V external power supply
20	–	–	Do not connect
21	–	–	Do not connect
22	–	–	Do not connect
23	–	–	Do not connect
24	–	–	Do not connect
25	–	–	Do not connect
26	MON-	Output	Analog monitor output (-)
27	MON+	Output	Analog monitor output (+)
28	–	–	Do not connect
29	–	–	Do not connect
30	JOG	Input	Jogging
31	DIR	Input	Jog direction
32	–	–	Do not connect
33	–	–	Do not connect
34	–	–	Do not connect
35	–	–	Do not connect
36	–	–	Do not connect
37	–	–	Do not connect

Caution : For the Input / Output signals of special-order Driver Unit, refer to its special document.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

5.2.3. Setting the Polarity (A or B contact) of the Input Ports

- The shipping set of polarity for all CN2 input signal ports is A contact.
- The polarity of some input signal ports can be changed to B contact in an ESA25 Driver Unit.
- The ports of which the polarity can be changed are only four signals below. The other ports are fixed to A contact.
  EMST : Emergency stop
  HLS : Home limit switch
  OTP : + direction overtravel limit switch (CW direction)
  OTM : - direction overtravel limit switch (CCW direction)
- The polarity can be changed by the parameter AB.
- The password input is necessary before inputting AB parameter.
- Table 5-6 shows the data and port. Refer to “Setting Example” below and the explanation of AB parameter.

Table 5-6

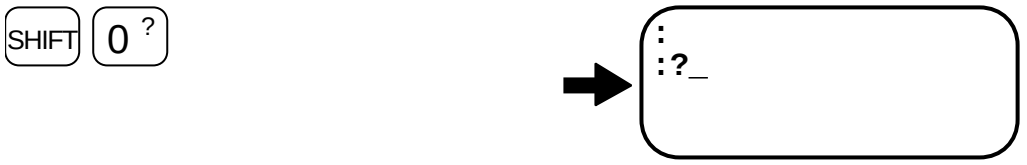
Data digit	n1	n2	n3	n4	n5	n6	n7	n8
CN2 Pin No.	25	12	24	11	23	10	22	9
Signal name	SVON	EMST	IOFF	HLS	HOS	CLR	OTM	OTP

- Meaning of data
  0 = A contact (normally open)
  1 = B contact (normally close)
  X = Cannot be changed just after read out the setting of polarity.
  When setting polarity, inputting X means no change of polarity of the port.
- See “12. Command and Parameter” for more details.

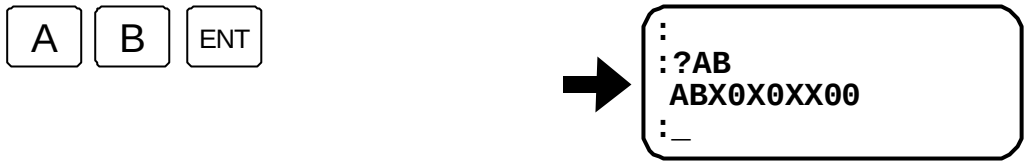
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

◆ Setting Example

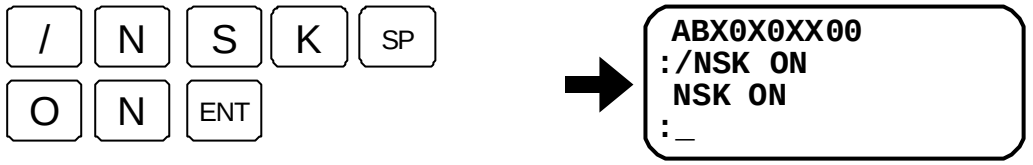
1) Press the code key while holding down the SHIFT key.



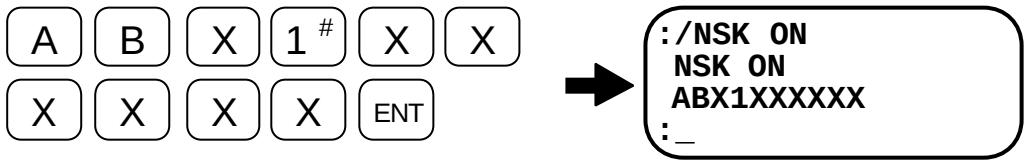
2) Input the command to read the setting of the AB parameter. Check the current polarity setting (in this example, all the input ports are set to A contact).



3) Input the password.
The password acknowledgment message appears on the display.



4) The second bit following AB represents EMST. Set this bit to “1”, and the other bits to “X” (no change).



● Thus, the polarity of EMST input signal port has been changed to B contact.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

5.2.4. Signal Specifications (CN2, CN5)

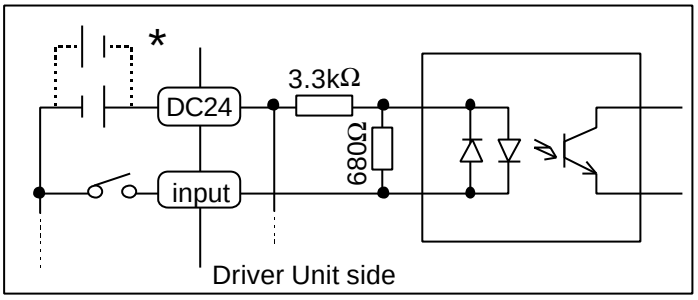
5.2.4.1. General Input

Applied Inputs : SVON, EMST, PRG0~5, RUN, HOS, HLS, JOG, DIR, OTP, OTM, CLR, IOFF

Table 5-7

Item	Specification
Input voltage	24 VDC ±10%
Input impedance	3.3 kΩ
Maximum current	10 mA (per input)

Figure 5-5



* The polarity of DC24V external supply may be reversed.

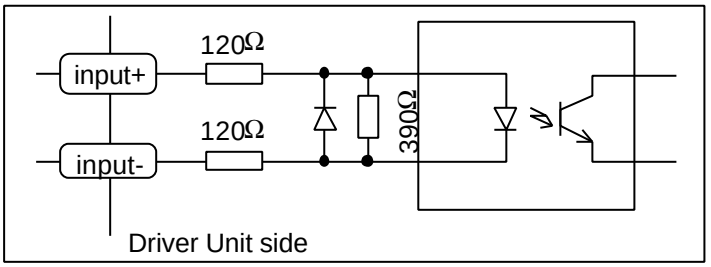
5.2.4.2. Pulse Train Input

Applied Inputs : CWP+, CWP-, CCWP+, CCWP-

Table 5-8

Item	Specification
Input voltage	5 VDC ±10%
Input impedance	240 Ω
Maximum current	25 mA

Figure 5-6



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

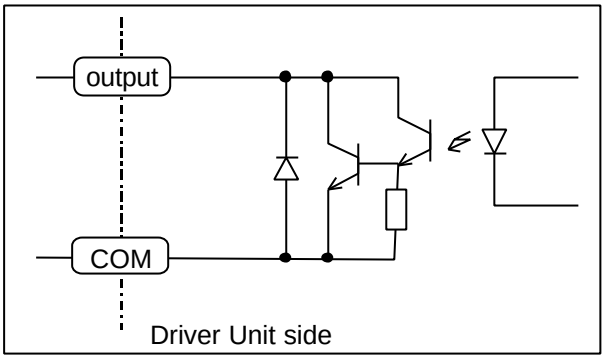
5.2.4.3. General Output

Applied Outputs : BRK, IPOS

Table 5-9

Item	Specification
Maximum load capacity	24 VDC/100 mA
Maximum saturated voltage	2 V or less

Figure 5-7



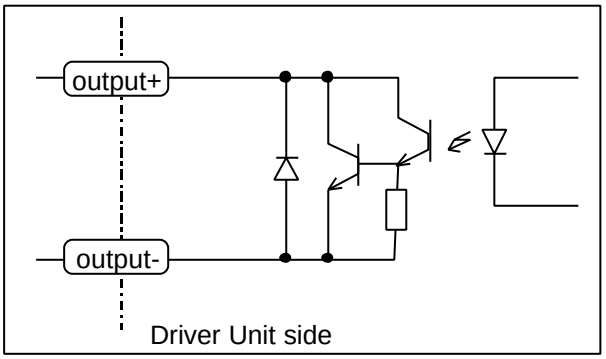
5.2.4.4. Alarm Output

Applied Outputs : DRDY+, DRDY-

Table 5-10

Item	Specification
Maximum load capacity	24 VDC/100 mA
Maximum saturated voltage	2 V or less

Figure 5-8



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

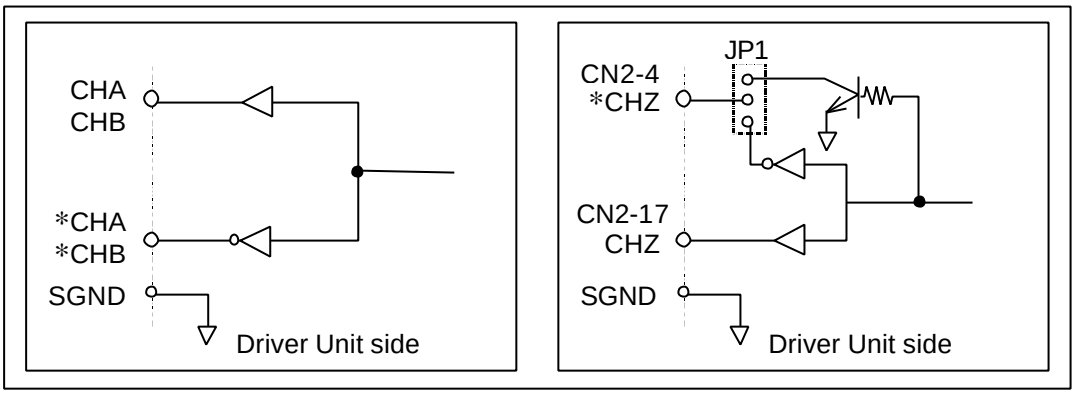
5.2.4.5. Position Feedback

Applied Outputs : CHA, CHB, CHZ, *CHA, *CHB, *CHZ

Table 5-11

Item	Specification	
Output format	Line driver (CHA, CHB, *CHA, *CHB) Line driver or open collector (CHZ, *CHZ) (Can be selected by Jumper 1. Refer to "4.2.4. Jumper")	
Line driver	Texas Instruments SN75ALS192	
Recommended Line receiver	Texas Instruments SN75ALS193 or AM26LS32 equivalent	
Maximum collector current	100mA	For open collector
Maximum collector voltage	24V	
Saturated voltage	1V or less	

Figure 5-9



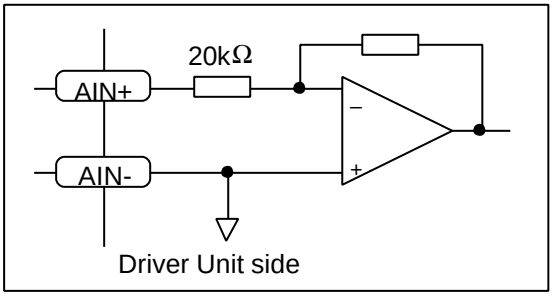
5.2.4.6. Analog Command Input

Applied Inputs : AIN+, AIN-

Table 5-12

Item	Specification
Max. input voltage	± 10VDC
Input impedance	20 kΩ
Max. input current	0.5 mA

Figure 5-10



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

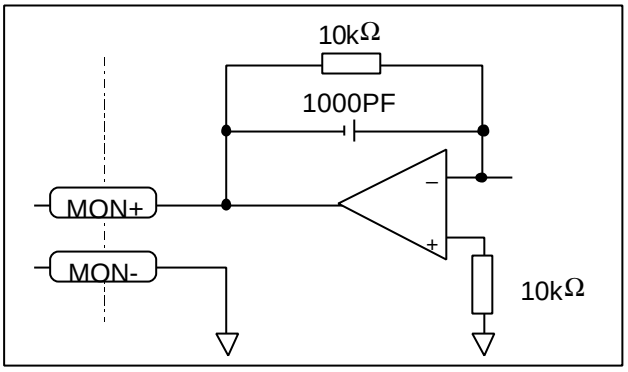
5.2.4.7. Analog Monitor Output

Applied Outputs : MON+, MON-

Table 5-13

Item	Specification
Output format	Ope-amp
Max. input voltage	±10V ±10%
Saturated voltage	4mA or less

Figure 5-11

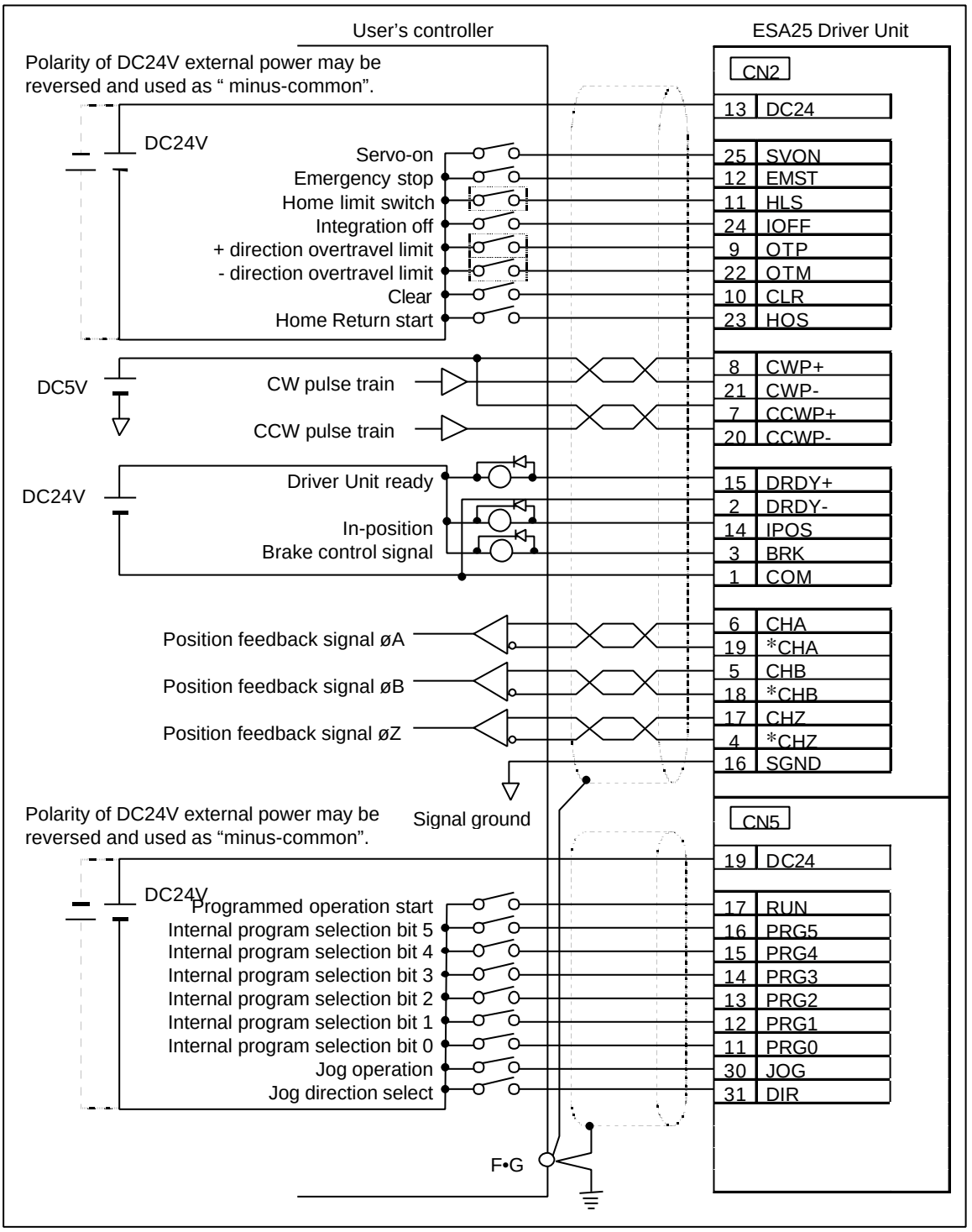


Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

5.2.5. Wiring Example (CN2, CN5)

5.2.5.1. Position Control Mode Wiring Example

Figure 5-12



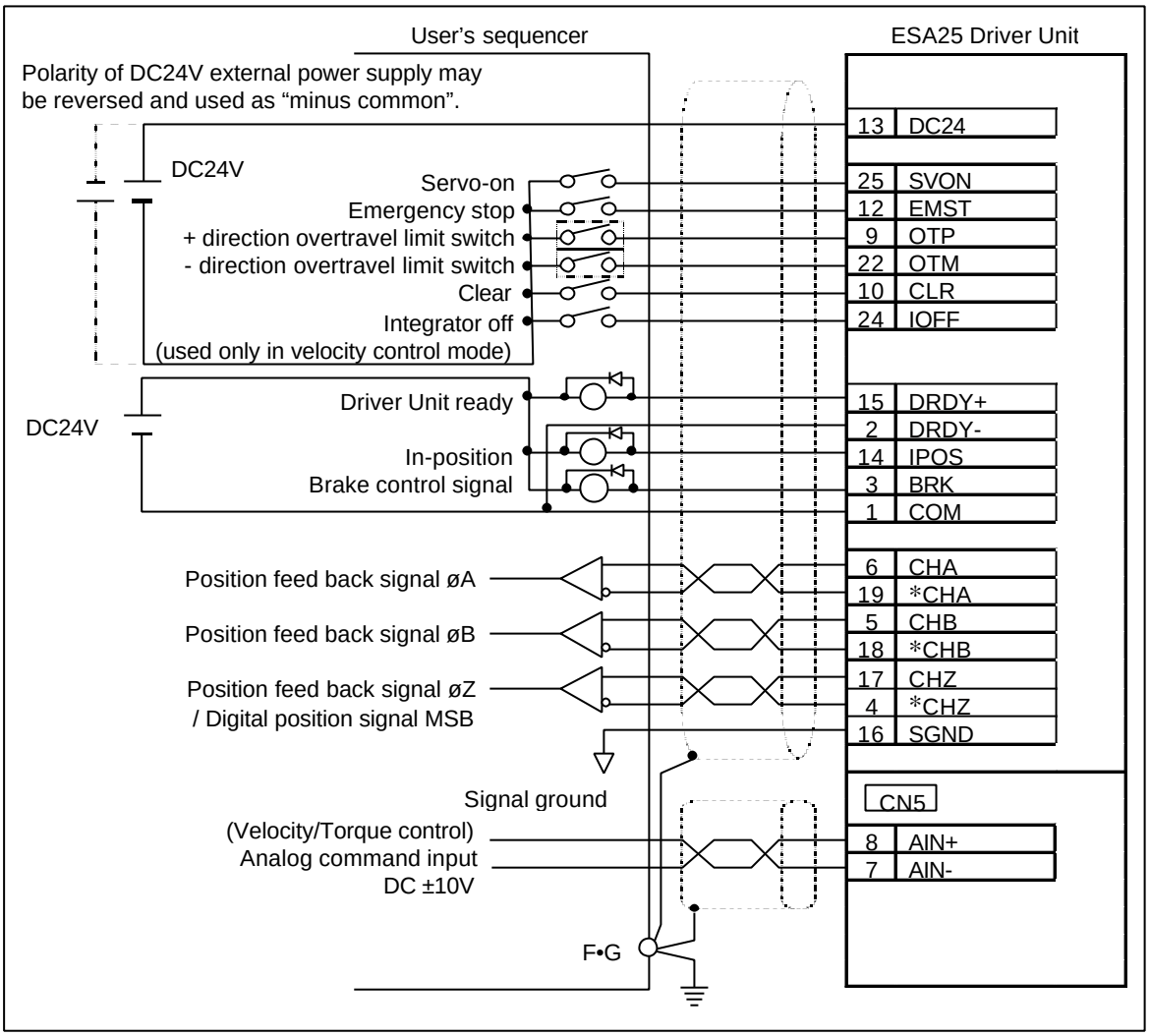
Caution : • *When using an inductive switch (e.g., relay), be sure to insert a serge killer circuit.*

• *When the user installs sensors as the Home position limit switch, + direction overtravel limit and - direction overtravel limit switch, connect sensor output directly with the input port of the Driver Unit, not via the master controller.*

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

5.2.5.2. Wiring Example of Velocity Control/Torque Control Mode

Figure 5-13



Caution : • *When using an inductive switch (e.g. relay), be sure to install a serge killer circuit.*

• *When the user installs sensors for the + direction overtravel limit switch and - direction overtravel limit switch, connect sensor output directly with the input port of the Driver Unit, not via the master controller.*

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

5.2.5.3. Wiring Example for YS Series Motor Equipped with Brake

- The brake built-in the YS series Motor is an electromagnetic brake that is released when the coil is exited (negative action type). The brake is non-backlash type when it engages.

- The brake may be used for safety in case of unexpected power shutdown, or to provide extra-holding torque when the Motor is on hold.

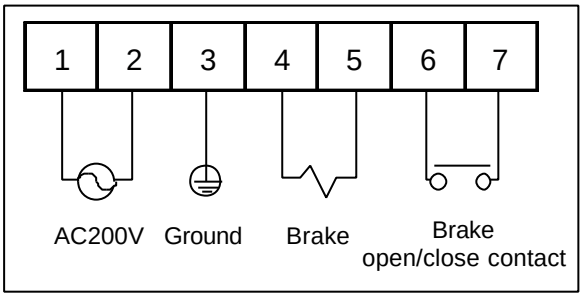
- Use an optional brake power supply because the brake is to be operated by the overexertion, switching full-wave or half-wave rectification. (full-wave rectification for overexertion, while half-wave rectification for holding).

  Reference number of optional power supply: M-FZ063-1

Table 5-14 : Main specification

Power voltage		AC200V ±10%	50 / 60 Hz
Output voltage/current	Overexcitation	DC180V·4A	Full -wave rectification
	Hold	DC90V·2A	Half-wave rectification
Overexcitation time		0.35 sec	
Ambient temperature		0 ~ 40°C	

Figure 5-14 : Terminal block wiring



Caution : • The brake output of the ESA type Driver Unit cannot be used to switch the brake directly ON or OFF. For this purpose, be sure to use the brake switch contacts externally.

• For brake on/off, use contacts with a capacity of more than 10 times of the inductive load current at 180 VDC

• Do not short-circuit No.4 and No.5 terminals with power on.

• Be sure to use No.6 and No.7 terminals to turn on/off the brake.

• Never open/close No.6 and No.7 terminals in AC power side.

Table 5-15

Motor size	Inductive load current (A)
YS2020	0.36
YS3040	0.50
YS4080	0.66
YS5120	0.72

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

● The brake signal must be controlled through the user's sequence.

Figure 5-15 : Recommended sequence diagram

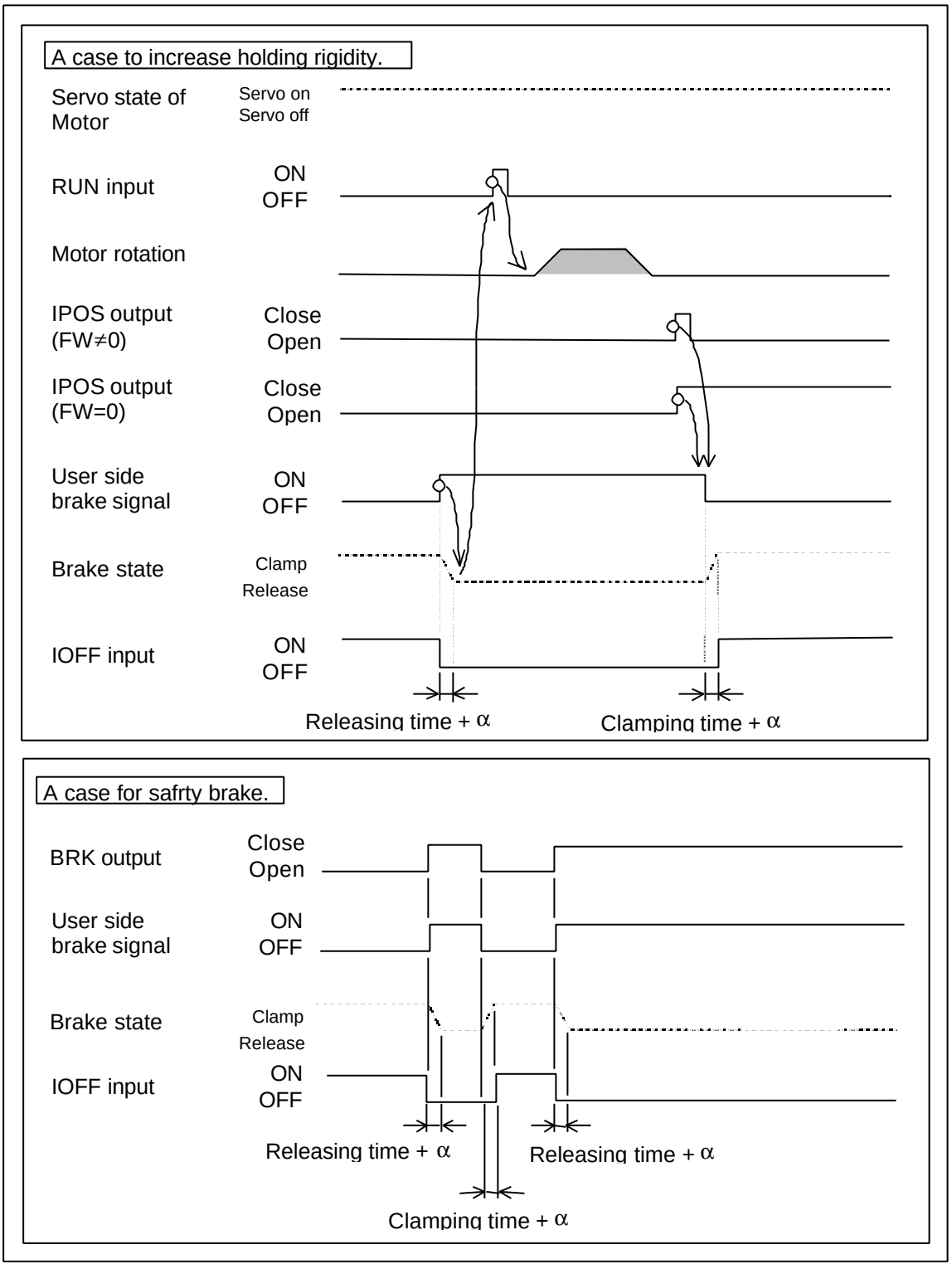
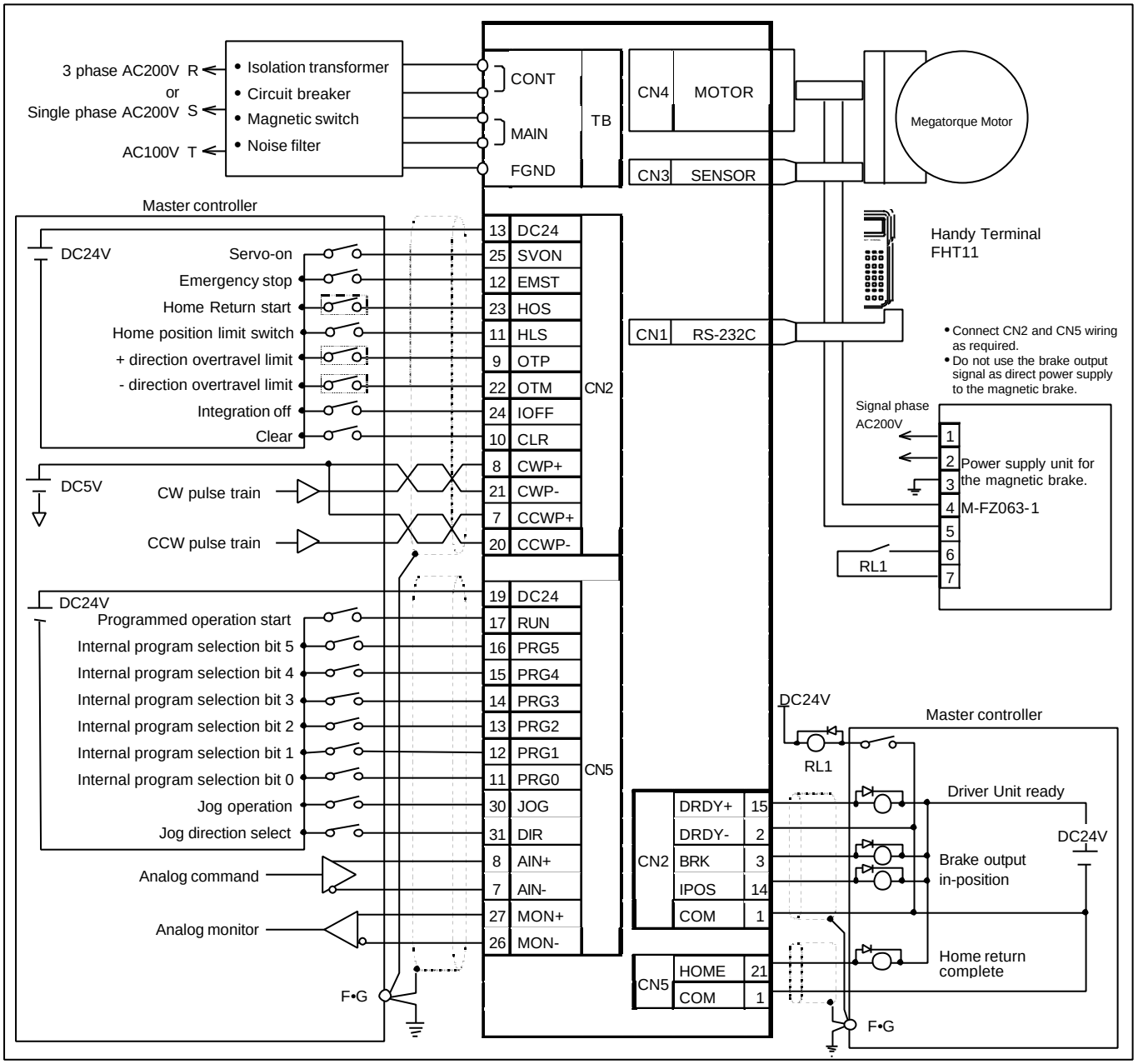


Table 5-16

Motor type	Brake model	Static friction torque (N·m)	Torsional rigidity (sec./N·m)	Brake engaging time (msec)	Brake releasing time (msec)	Capacity (W)
YS2020	RNB2K	20	4.5	26	10	17
YS3040	RNB4K	40	4.9	62	3	23
YS4080	RNB8K	80	1.3	66	5	30
YS5120	RNB12K	120	1.9	78	9	33

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Figure 5-16 : Wiring example with brake



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

5.3. CN3 : Resolver Cable Connector

- Since the resolver cable supplied with the Megatorque Motor System should always be used, you need only plug the resolver cable connector into CN3. Knowledge of the pin assignment or signal names is not necessary. This section is offered for reference.

Caution : *• Do not change the length of the cable.*

• Do not use other connector between the Resolver cable and CN3.

Danger : *• Never connect pins not listed below.*

• Insert the connector being careful of its orientation. Tighten the screws for fastening the connector so that it will not be loosened by shock.

• Never connect/disconnect the CN3 connector when the Driver Unit power is on.

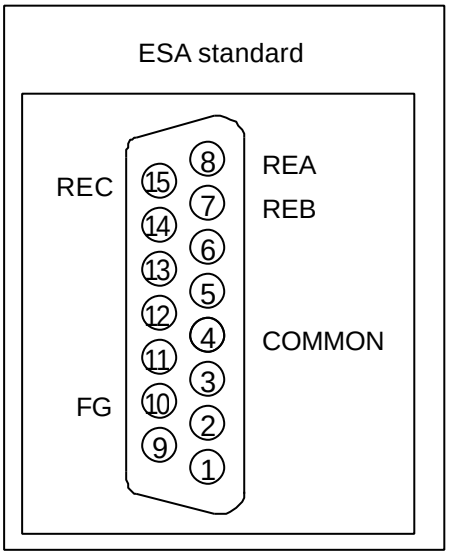
Table 5-17

Driver Unit connector	Japan Aviation Electronics Industry, Limited	DALC-J15SAF-13L9
Mating connector type *	Japan Aviation Electronics Industry, Limited	DA-15P-N
Mating connector shell type *	Japan Aviation Electronics Industry, Limited	DA-C1-J10

* Provided with the cable.

5.3.1. CN3 Pin-out

Figure 5-17 : CN3 Pin-out



5.3.2. CN3 Signal List

Table 5-18 : CN3 Signal List

Pin	Signal Name	Function
8	REA	Resolver signal phase A
7	REB	Resolver signal phase B
15	REC	Resolver signal phase C
4	COMMON	Common
10	FG	Frame ground

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

5.4. CN4 : Motor Cable Connector

- Since the Motor cable supplied with the Megatorque Motor System should always be used, you need only plug the Motor cable connector into CN4. Knowledge of the pin assignment or signal name is not necessary. This section is offered for reference.

Caution : *• Do not change the cable length.*

• Do not use other connector between the Motor cable and CN4.

Danger : *• Be careful for orientation of the connector when inserting it. The connector is a self-lock type. Insert the connector to its bottom, otherwise it will not lock.*

• Never insert/remove the CN4 connector with the Driver Unit power turned on.

• A high voltage is applied to this connector after the power is turned on. Be very careful not to cause short-circuit.

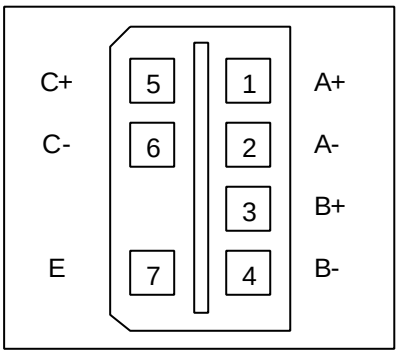
Table 5-19

Driver Unit connector	AMP 172039-1
Mating connector type * (user device side)	AMP 172495-1
Mating connector shell type * (user device side)	AMP 172774-1

* Provided with the cable.

5.4.1. CN4 Pin-out

Figure 5-18 : CN4 Pin-out



5.4.2. CN4 Signal List

Table 5-20 : Signal Name and Function

Pin	Signal Name	Function
1	A+	Motor winding phase A (+)
2	A-	Motor winding phase A (-)
3	B+	Motor winding phase B (+)
4	B-	Motor winding phase B (-)
5	C+	Motor winding phase C (+)
6	C-	Motor winding phase C (-)
7	E	Motor grounding wire

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

5.5. TB : Terminal Block for Power Supply

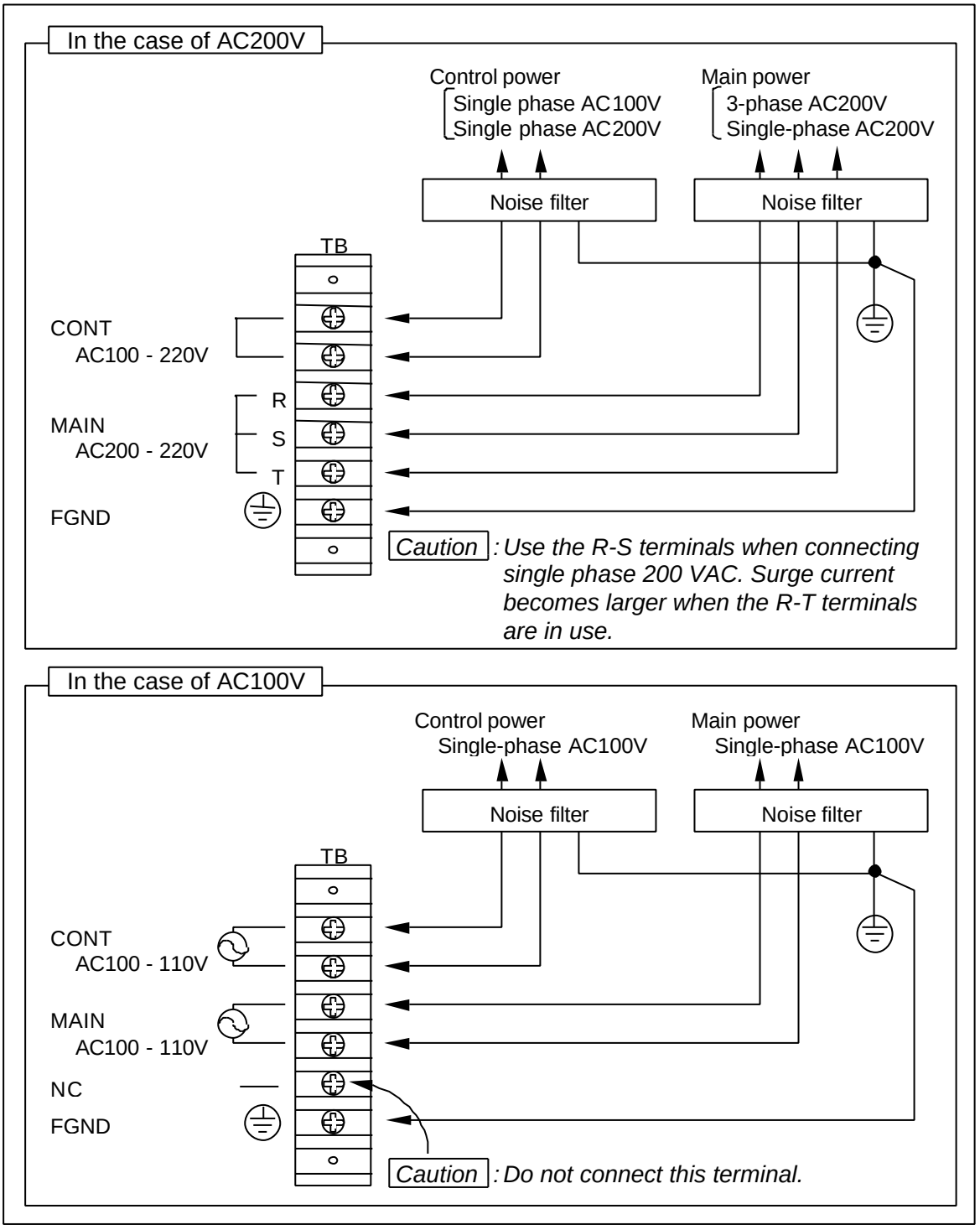
5.5.1. Terminal List

Table 5-21 : Terminal Labels and Functions

Terminal Label	Function
CONT	Control power input
MAIN	Main power input
FGND	Frame ground

5.5.2. Wiring Diagram (TB)

Figure 5-19 : Wiring diagram (TB)



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

(Blank Page)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

6. Installation

6.1. Unpacking and Inspection

- Make sure that you have received the following units.
  1) Megatorque Motor
  2) Driver Unit (CN2 and CN5 mating connectors and 2 fuse holders are included.)
  3) Cable Set (Motor and Resolver cable set)

- Inspect shipping containers for damage as an indication that they might have been mishandled in transit.

- When unpacking the System, save all packing materials for reuse in the event that the System needs to be shipped or require service.

  Danger : *Inspect the Motor and the Driver Unit very closely for damage which might have occurred in transit. The Driver Unit is particularly fragile and should be inspected for warped or bent sheet metal, broken standoffs, and loose or damage electric components.*

- Rotate Motor's rotor by hand, without turning on power. The rotation should be smooth.

- If you suspect damage, do not apply power to the System, since this can cause immediate catastrophic damage to the Driver Unit. Furthermore, a damaged system could be a potential electric shock hazard. Notify the carrier immediately, and call your NSK representative.

  Caution : *Make sure that the combination of Motor and Driver Unit conforms to your requirement.*

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

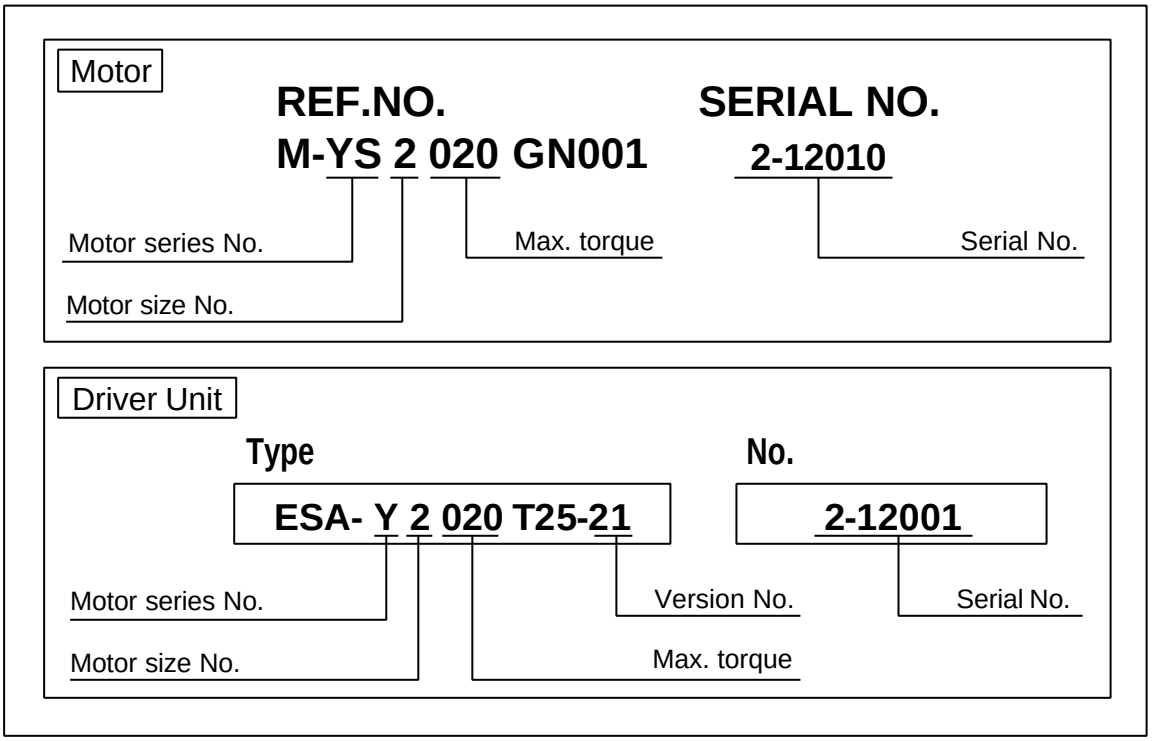
6.2. Combination of Motor and Driver Unit

Caution : Make sure that the combination of Motor and Driver Unit conforms to your requirement.

Check and record the Motor and Driver Unit reference number and serial number.

- Standard Combination
  - ◊ The Motor series, size and maximum torque numbers in both Motor and Driver Unit reference number must be the same.
- Special-order Combination
  - ◊ Refer to the respective specification document.
- Even when the Motor and Driver Unit are in an interchangeable combination, check reference number in same manner as Standard combination. If the combination is not interchangeable, serial numbers of Motor and Driver Unit must be same.
- A nameplate is attached to individual Motor and Driver Unit. Configuration of each plates are shown in Figure 6-1. Refer to "3.2. Reference Number Configuration" for the more details.

Figure 6-1



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

6.3. Motor Mounting

- The high acceleration/deceleration characteristic of a direct drive mechanism requires the system to have high mechanical rigidity. Therefore, it is essential to maximize rigidity of the Motor and the load system.

- The Motor will work best if all of the elements have a natural frequency between them of at least 100 Hz, and preferably more than 200 Hz.

Warning : *• Fully fasten all the mounting holes (mounting tap holes) of the Motor.*

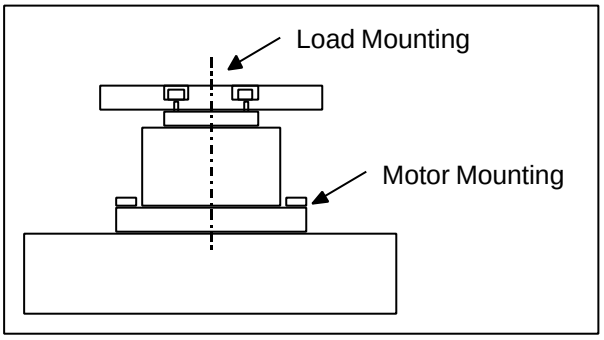
• Fasten a work to the attachment using all of the tapped holes of the rotor.

• Eliminate play between the load and the rotor.

• Eliminate play in the mechanism as much as possible.

Warning : *The flatness of the surface where the Motor is mounted affects Motor operation. Approximately 0.02 mm flatness is needed for smooth operation. When mounting, minimize the looseness between Motor and the mounting surface.*

Figure 6-2 : Motor Mounting



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

6.3.1. Bearing Load

6.3.1.1. Attaching the Load

- The load must be attached to the rotor flange using the threaded mounting holes in the rotor. All of the bolts should be used, and they should be tightened to prevent slippage.

6.3.1.2. Bearing Load

- The Motor uses a heavy duty bearing that can support most loads directly.

Table 6-1 : Maximum Bearing Load (YS Series)

	YS2005	YS2020	YS3008	YS3040	YS4080	YS5120	YS5240
Axial Load Capacity (N)	3 700		4 500		9 500	19 600	
Moment Load Capacity (N·m)	60		80		160	400	
Distance between Rotor Surface and Bearing Center* (mm)	26.0	46.5	25.5	52.5	54.0	58.5	

* Use these values when calculating the moment load.
Refer to "4.1. Motor Specification" for the details.

Caution : *When vibratory axial load is applied, the equivalent allowable load of the Motor shall be less than 2~3 times of the vibratory load.*

Table 6-2 : Maximum Bearing Load (JS Series)

	JS0	JS1	JS2
Axial Load Capacity (N)	950	1 960	3 700
Moment Load Capacity (N·m)	10	40	60
Distance between Rotor Surface and Bearing Center* (mm)	31	32	30

* Use these values when calculating the moment load.
Refer to "4.1. Motor Specification" for the details.

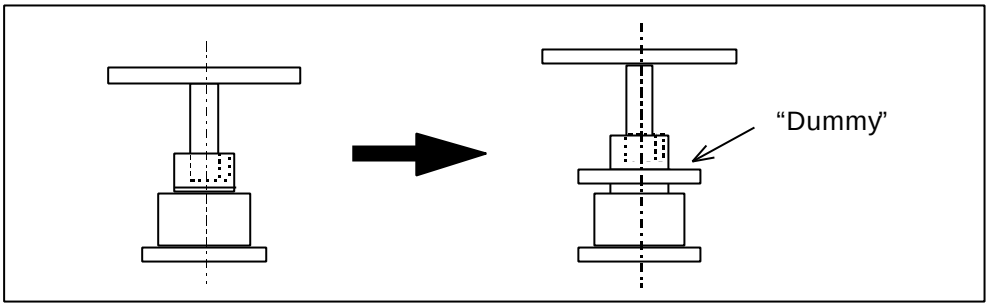
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

6.3.2. Using a “Dummy” Load

- When you have to drive the Motor with a low-stiffness load, you may not be able to avail of the merits of the Megatorque Motor System. In some cases, a little rearrangement of mechanical design may help. Try to add some load (“dummy” inertia) to the rotor directly.

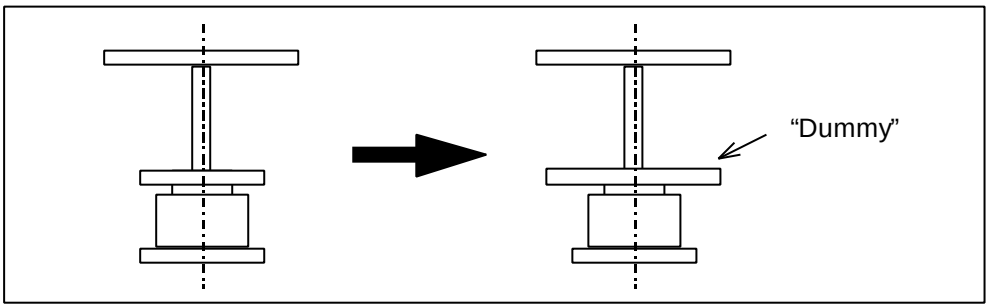
◆ Example 1 : Load is connected using keyway.

Figure 6-3 : Using Keyway



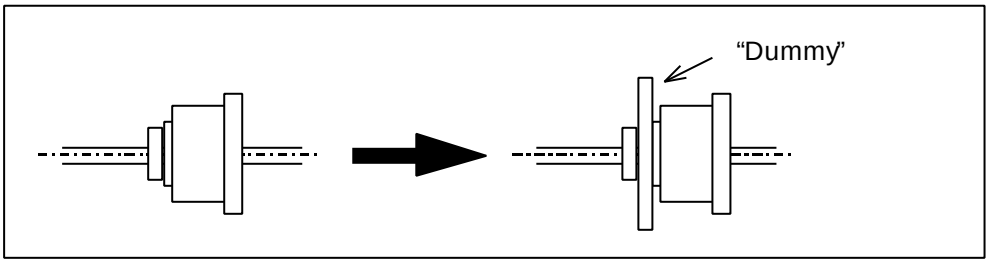
◆ Example 2 : Load is directly attached but the shaft diameter is too small. (Torsional vibration may occur.)

Figure 6-4 : Using Small-Diameter Shaft



◆ Example 3 : Driving ball screw. (Inertia of the whole mechanism is very small.)

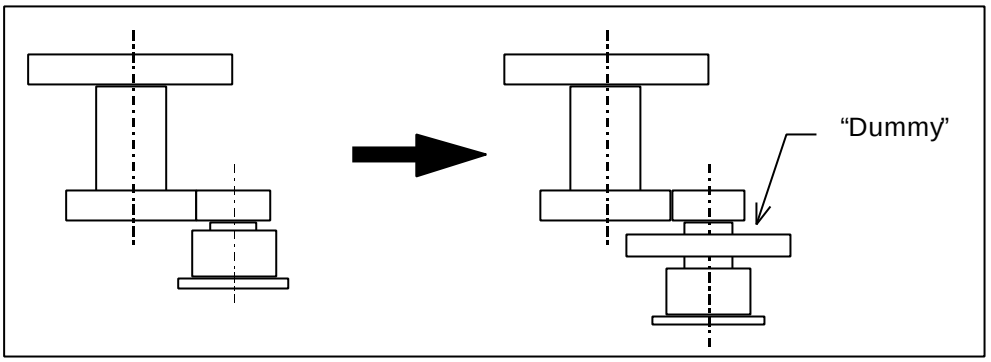
Figure 6-5 : Driving Ball Screw



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

◆ **Example 4 : Load is connected using sprocket chain or gear mechanism. (There may be backlash.)**

Figure 6-6 : Using Sprocket Chain Or Gear Mechanism



1) For smooth drive, the inertia of directly attached load should be:

$$Jd = Ji \times 0.2$$

where

Jd : inertia of directly attached load
Ji : inertia of indirectly attached load

Example:

- When the inertia of indirectly attached load (Ji) is 0.5 kg·m^2, the inertia of directry attached load (Jd) shall be :

$$Jd = 0.5 \times 0.2$$
$$= 0.1 \text{ kg·m}^2$$

2) When driving a speed reduction;

$$\frac{Ji}{r^2 \times Jd} \leq 5$$

where

Jd : inertia of directly attached load
Ji : inertia of indirectly attached load
r : speed reduction ratio

Example:

- When

inertia of indirectly attached load Ji: 20 kg·m^2
speed reduction ration r : 1 : 3

the inertia of directry attached load (Jd) shall be:

$$Jd \geq \frac{Ji}{r^2 \times 5}$$
$$\geq \frac{20}{3^2 \times 5}$$
$$\geq 0.444 \text{ kg·m}^2$$

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

6.3.3. Load Inertia

- Generally, the load inertia is much bigger than the rotor inertia of the Motor. The following table shows the approximate inertia capacity. (Inertia is shown as J in kg·m^2.)

Table 6-3 : Inertia Capacity *(Unit: kgm^2)*

	High speed positioning	General use	Large inertia (Low speed positioning)
YS2005	0.006 ~ 0.25	0.25 ~ 0.5	–
YS2020	0.025 ~ 1	1 ~ 2	–
YS3008	0.01 ~ 0.4	0.4 ~ 0.8	–
YS3040	0.05 ~ 2	2 ~ 4	–
YS4080	0.1 ~ 4	4 ~ 8	–
YS5120	0.15 ~ 6	6 ~ 12	12 ~ 30
YS5240	0.3 ~ 12	12 ~ 24	24 ~ 125
JS0002	0.003 ~ 0.1	0.1 ~ 0.2	–
JS1003	0.004 ~ 0.15	0.15 ~ 0.3	–
JS2006	0.008 ~ 0.3	0.3 ~ 0.6	–
JS2014	0.018 ~ 0.7	0.7 ~ 1.4	–

Caution : Refer to "4.1. Motor Specification" for allowable axial load and moment load to confirm the Motor capacity for actual use conditions.

6.3.4. Fluctuating Load Inertia

- Changes in the inertia load directly influence the performance and stability of direct drive motors. In the case of large changes in the load inertia it may be necessary to change the servo loop gain. To minimize the effect of load inertia fluctuations, the ratio of inertia fluctuation should be kept as small as possible, preferably less than 1:

$$Ri = \frac{Jmax - Jmin}{Jrotor + Jmin}$$

(Where Ri = ratio of inertia fluctuation, Jmax = load inertia at maximum, Jmin = load inertia at minimum, Jrotor = rotor inertia)

6.3.5. Motor Operating Condition

◊ Ambient Temperature : 0 ~ 40°C.

◊ Relative Humidity : 20 ~ 80 % (Non-condensing)

◊ Indoor use only

◊ The area where the Motor is mounted must be free of corrosive gas, dirt, dust and any other contamination.

- YS and JS Motor series are not water-tight. If the Motor is to be used where smaller particles and/or water may be present, it must be protected by another cover or enclosure.

- Do not apply any machining, such as drilling or cutting.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

6.4. Driver Unit Mounting

- The ESA25 Driver Unit may be mounted by the holes in brackets.

  Caution : *For proper air circulation, clearance is required above and below of the unit. (see Figure 6-7)*

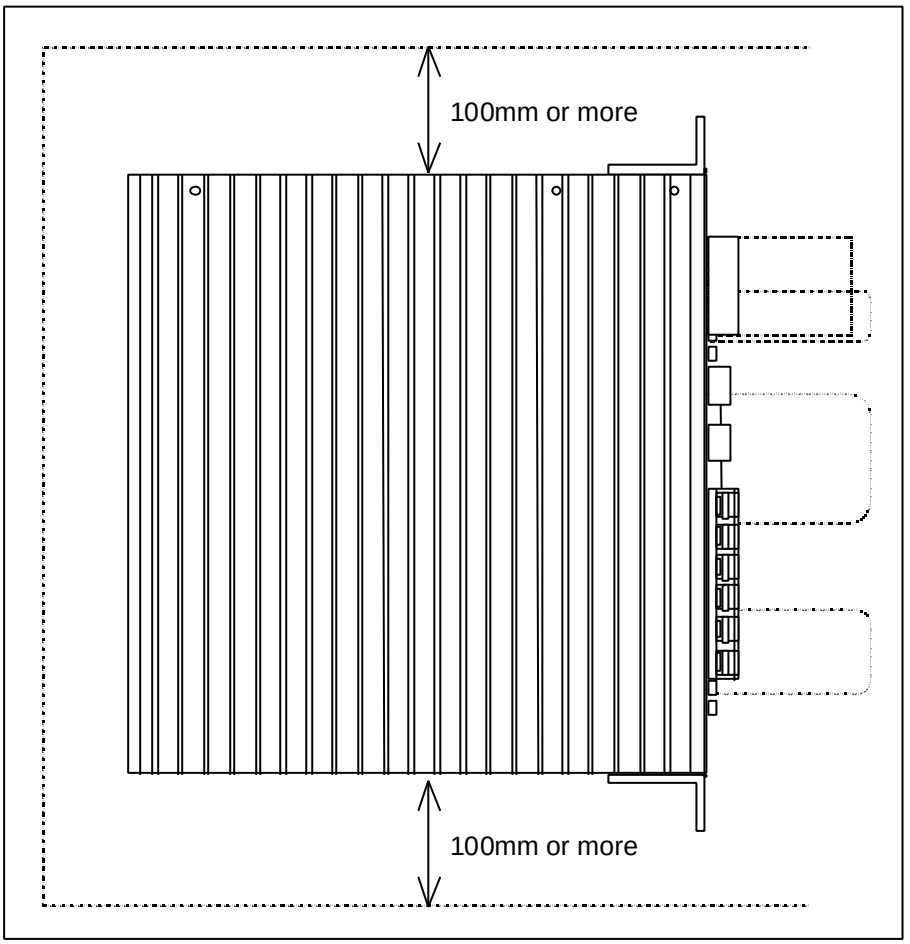
- Be careful not to contaminate the Driver Unit with cutting chips and/or other contamination when wiring and installing the Driver Unit.

- Use the Driver Unit in the environmental condition of Installation Category I and Pollution Degree 2. The covers of the Driver Unit do not work as an enclosure against flame or electric shock. Install the Driver Unit into an enclosure and keep the internal temperature of the enclosure within 0 to 50°C. If the heat sink overheat alarm arises frequently, provide an air-cooling measures such as a fan. (See "14. Alarm.")
  For some environmental condition it might be necessary to prepare the enclosure of which protection degree is IP 54 or better.

  Caution : *When installing two or more Driver Units for multi-axis combinations, give a space of about 100 mm more between adjacent Driver Units.*

- ESA25 Driver Unit has brackets for easy fixing to the control box or enclosure.

Figure 6-7



- The area where the Driver Unit is mounted must be free of water, corrosive gas, dirt, dust and any other contamination.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

6.4.1. Connecting Power

- The main power AC line input supplies the power to the high voltage supply for driving the Motor.
- The voltage supplied to the Motor may be three phase or single phase. If the application involves low speeds less than 0.5 s^{-1}, then single phase power will be adequate. If the application requires high torque and speeds greater than 0.5 s^{-1}, then the best Motor torque/speed performance is obtained by supplying three phase power at a higher voltage.
- The control power AC line input supplies power to the internal low voltage switching power supply for the logic and signal circuits. The internal switching power supply will operate from any single phase AC voltage from 90 up to 240 volts.
- The AC power for the control power input may be obtained from the same supply that is connected to the main power AC line input.
- The AC line power consumption varies with the Motor size, the Driver Unit type and the load. The Megatorque Motor System requires very little power when it is moving at zero or low speed, even at maximum torque output. The power consumption is highest when the Motor is producing significant amounts of torque at elevated speed, more than 20% of the maximum rated speed.
- Use 2.0 mm^2 (14AWG) or larger wire with heat-proof vinyl for power line.
- The electrical noise from outside sources and the System itself may interfere with proper operation. The protection from electrical noise must be designed into the installation. Use a line noise filter on the AC supply. A suitable noise filter may be obtained from NSK. If you supply your own, it should meet the requirements in Table 6-4.

Table 6-4 : Noise Filter Requirement

Driver Unit AC Line	Noise Filter Voltage Rating	Current Rating
220VAC, 3ø	250V AC/DC	15A AC/DC
220VAC, 1ø		
110VAC, 1ø		
Control Power	250V AC/DC	5A AC/DC

- Do not tie wrap the input and output sides of the AC line filter together, or place them in close proximity. Do not tie wrap the ground wires with signal wires.
- The noise filter must be installed on control power AC line, separately from the main power line.

Warning *: An isolation transformer must also be used to prevent electrical shock. Contact NSK if you need information about isolation transformers. If you supply your own, the transformer must have enough capacity for the Motor power consumption. Refer to "4.2.2. General Specification" for the required power of the Motor.*

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

- Do not place the main power AC line input supplies and signal wires in close proximity. Do not tie wrap them and not put in the same duct.

- The Driver Unit and the noise filters must be close to each other and wiring must be of minimal length. Do not insert contacts like a magnetic switch or a relay between them.

- Install a circuit breaker on the main power AC line. When the power is turned "ON", an inrush current to the circuit will occur because of the capacitive load connected to the main power supply circuit.

- When inserting contacts into the power supply circuit, the specification of the contact should be greater or equal to ones in the following table:

Table 6-5 : Contact Requirements

Contacts	For ESA Type
No-Fuse Breaker	Current Rating 15A
Short-Circuit Breaker	Contact Capacity 15A Sensitivity 15mA
Magnetic Switch	Contact Capacity 30A

Table 6-6 : Inrush Current

Item	Inrush Current (TYP)	
	AC100V	AC200V
Control Power	7A	14A
Main Power	80A	140A

- Install a surge killer circuit for magnet switches, relays and solenoids.

- When replacing the fuse F1 or F2 of the Driver Unit, use the fuse provided with the Driver Unit.

Caution : *• Use the R-S terminals when connecting single-phase 200 VAC for the main power supply. Surge current becomes larger when the R-T terminals are in use.*

• During wiring, be careful not to loose terminal block screws, etc.

Danger : *Install the plastic protection on TB Terminal Block after wiring. The terminals on TB will be at high voltage when power is turned on. Removing the protection and touching terminals may cause extreme electrical shock.*

Note : Refer to "5. Connector Specification" for the connector wiring.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

6.4.2. Ground Connection and Wiring

- For grounding Driver Unit, use heavy gage cable as possible, such as a flat braided copper cable or a wire 3.5mm^2 (AWG 10) or larger.

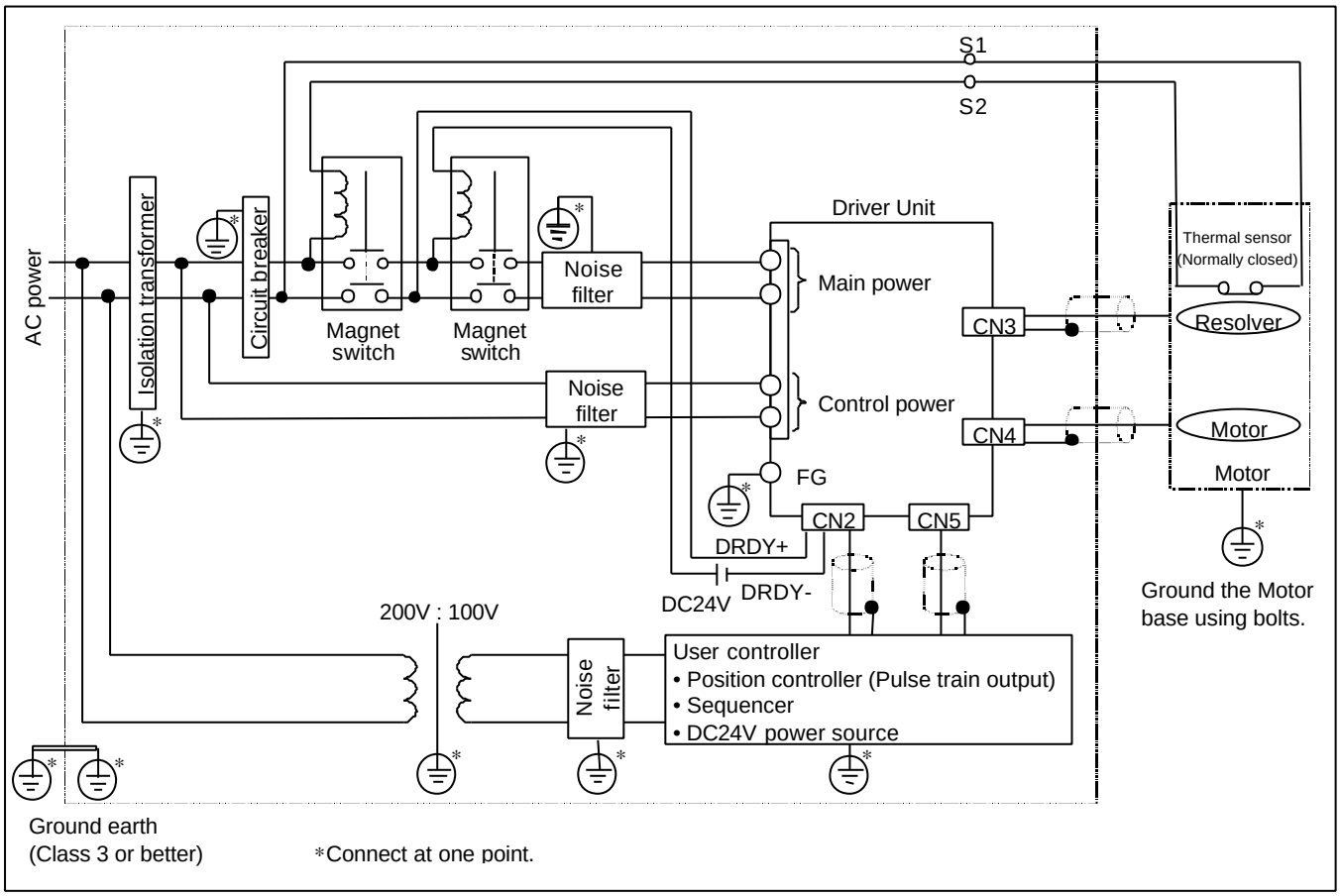
  Warning : *All the ground lines must be connected at one point and the grounding resistance must be under or equal to 100W.*

  Caution : *Connect the shield of the signal shielded cable (CN2) to the FG terminals (or SG terminals) of the master controller. If runaways are caused by noise, connect the shield to the FG terminal of the Driver Unit.*

  Caution : *Make sure to earth the Motor base when it is isolated from the machine base.*

- Figure 6-8 shows the wiring example. (This is provided as an example, not the instruction.)

Figure 6-8 : Wiring Example



Caution : *• We recommend to use the noise filter listed below as the measures for EMC Directive.*

Single phase 200V	: Equivalent to FN2070-10	(Shaffner EMC Ltd.)
Single phase 100V	: Equivalent to FN2070-16	(Shaffner EMC Ltd.)
3 phase 200V	: Equivalent to FN358-16	(Shaffner EMC Ltd.)

• The isolation transformer and the circuit breaker shall conform to the relevant European safety regulations.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

6.4.3. Motor Thermal Protection

- The thermal protection circuit must be installed to prevent the Motor from overheating.
- YS and JS Motors have a built-in thermal sensor. The lead wires of the sensor are connected to the Motor connector.
- A Cable Set has the outlet lead wires for the protection circuit. Refer to “3.2.3. Cable Set” for sensor lead wires.
- The protection circuit must be set to turn off the main AC power supply when the sensor is activated. Refer to Figure 6-8 “Wiring Example” to install the protection circuit that uses 2 lead wires S1 and S2.
- Thermal sensor specifications
  - ◊ Contact : Normally close
  - ◊ Rating Maximum : 250VAC 3.5A
  - ◊ Rating Minimum : 6V 0.15A
  - ◊ Type : T100R1U1N (Matsushita Electric)
    (Temperature set : 100°C)
  - ◊ Conforms to VDE.
  - ◊ The sensor is “self resetting” type. When temperature drops 15°C from the set value, it returns to normal state. Wait for 30 minutes or more after the protection circuit is activated and then turn on the power again.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

6.5. Connecting Motor and Driver Unit

- User must specify the Cable Set length when ordering. Select from 2, 4, 8, 15 and 30m.

Caution : *• Do not make the Cable set length longer or shorter. Changing cable length may worsen the performance of the Motor and the Driver Unit. Optional Cable set is available in length of 2, 4, 8 ,15 and 30 meters.*

• Do not place the power lines (AC power supply and Motor cable) and the signal lines (CN2 and Resolver cable) in close proximity. Do not tie wrap them and not put in the same duct.

• Connect the Cable Set to Motor connector and Driver Unit connectors CN3 and CN4 as shown in Figure 6-9 and 6-10.

Figure 6-9 : YS Motor

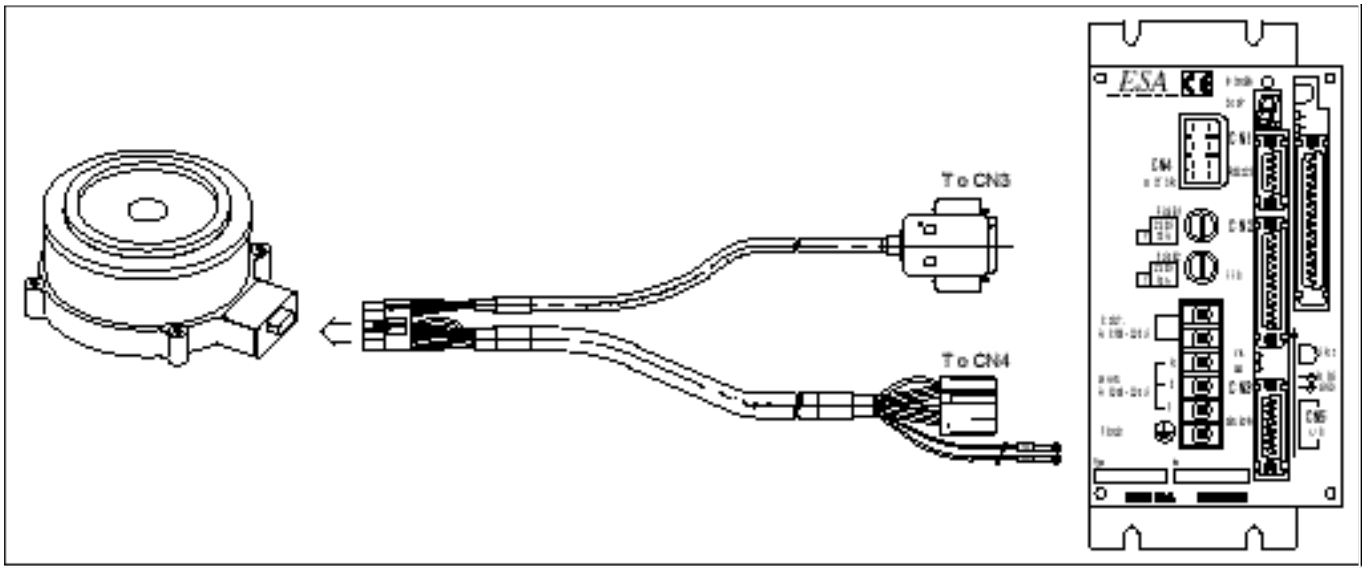
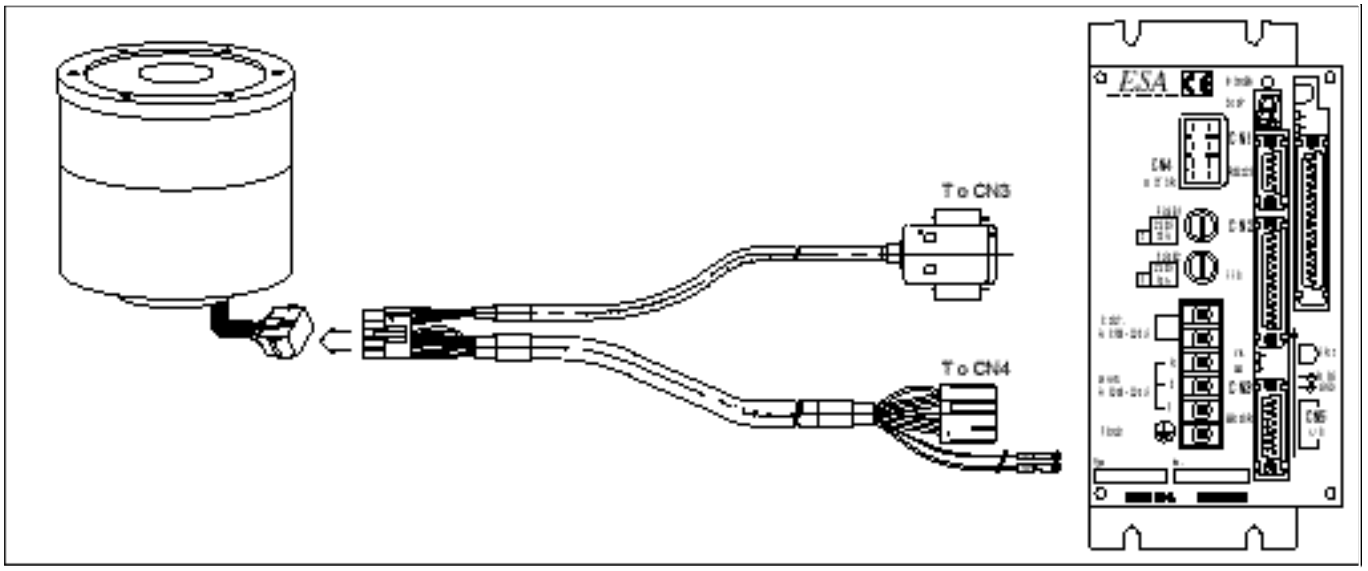


Figure 6-10 : JS Motor



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

6.6. Power on and Servo on

6.6.1. Precautions

Caution : *Before turning on the main power, check the following.*

(1) Wiring of connectors
(2) Connecting Cable of Motor and Driver unit.
(3) Safety

Danger : *Always stay in a safe place.*

Warning : *Confirm that the Motor is securely fixed to the mounting base and the load is fixed to the Motor. Fully fasten all the mounting bolts.*

Danger : *The working area of the Motor must be protected from the operator.*

6.6.2. Turning Power on

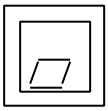
1 Turn on the power

2 Make sure that the LED of the Driver Unit and the Handy Terminal display are indicating that the system is ready for operation.

1) Normal state

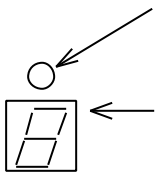
- Figure 6-11 shows the LED indicator in normal condition.

Figure 6-11



2) Abnormal

Figure 6-12



Green LED: Turns on when the power is turned on.
Normal : Green
Abnormal : Orange

7-segment LED display: Indicate the type of alarm.
- The alarm is normally indicated by a 2-digit code. Two characters are displayed alternately at certain intervals.
- When two or more alarms are detected, their codes are also indicated alternately at certain intervals.

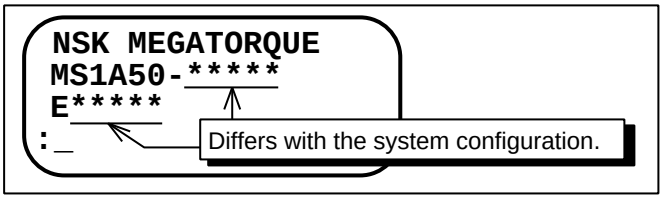
- Refer to “14. Alarms” for more details.

3) Handy Terminal display

- If a message “NSK MEGA...” is displayed on the Handy Terminal, the system is ready for operation. A colon (:) indicates that a command can be entered.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Figure 6-13 : Handy Terminal display (In normal state)



6.6.3. Turning Servo on

Figure 6-14 : Power "ON" sequence

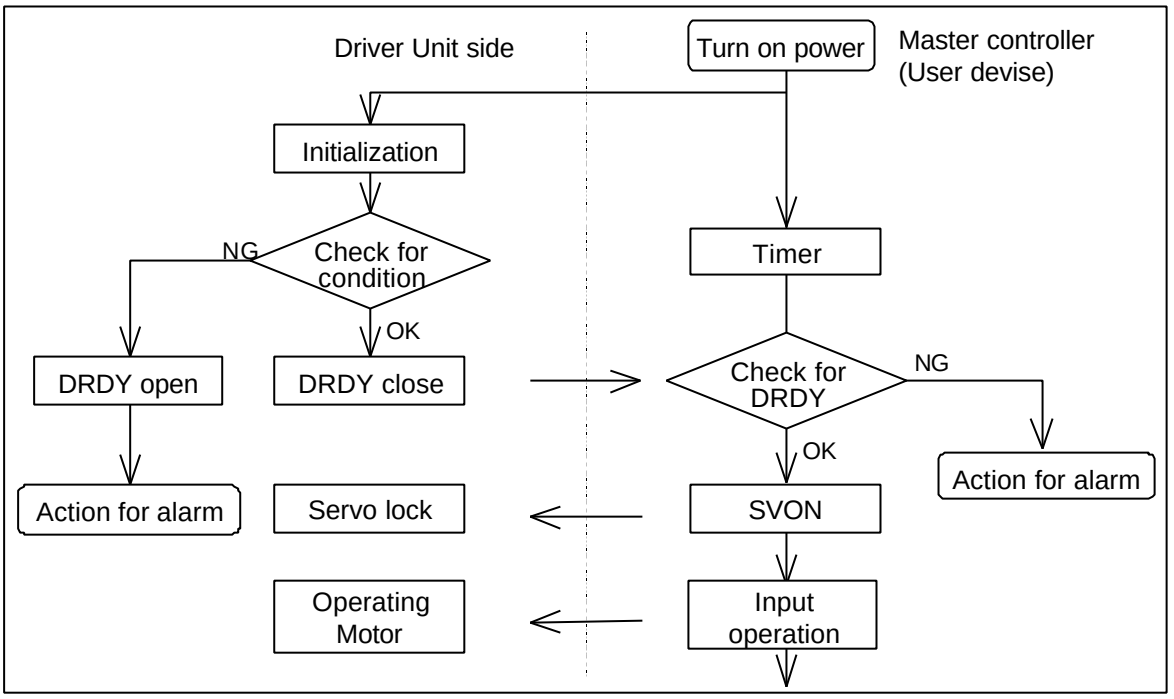
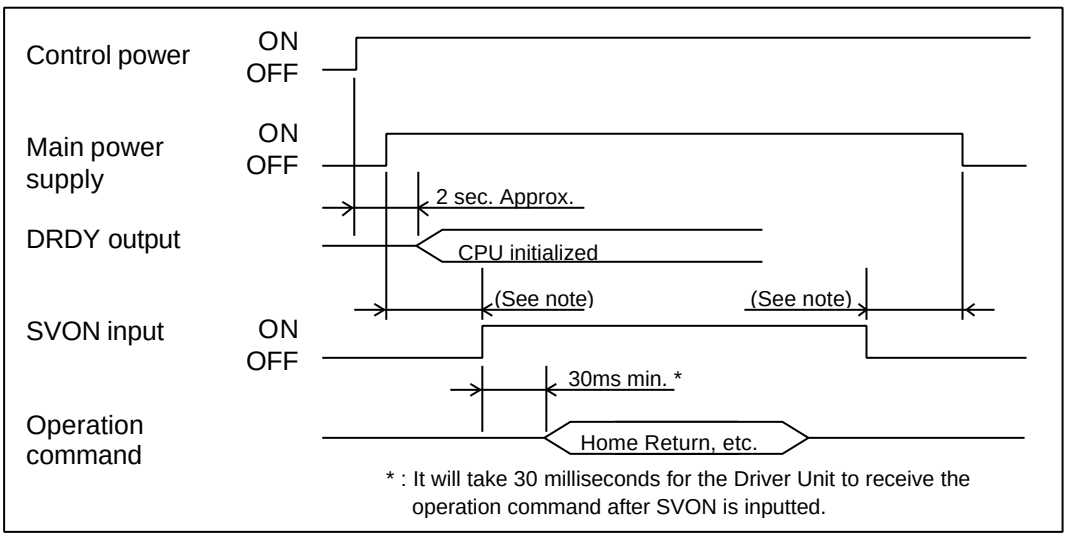


Figure 6-15 : Power ON / SVON timing



Caution : *Turn on the main power supply first, then the SVON input. When turn off the main power supply, turn off SVON first. If the main power supply is turned off in the servo-on state, the Driver Unit outputs the AC Line under-voltage alarm. Once this alarm occurs it will not recover unless the power is turned on again.*

◊ Figure 6-14 and 15 show timing of power "ON" and SVON.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

(Blank Page)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

7. Handy Terminal Communication

- Setting of various parameters, trial running, and adjustment are possible by inputting commands to the Driver Units through NSK Handy Terminal FHT11. (i.e., communication through the RS-232C interface).
- The Driver Unit has CN1 as the Input/Output ports for RS-232C communication.
- FHT11 Terminal can be a daisy chain communication terminal. Refer to "9.3.4. Daisy Chain Communication" for details.

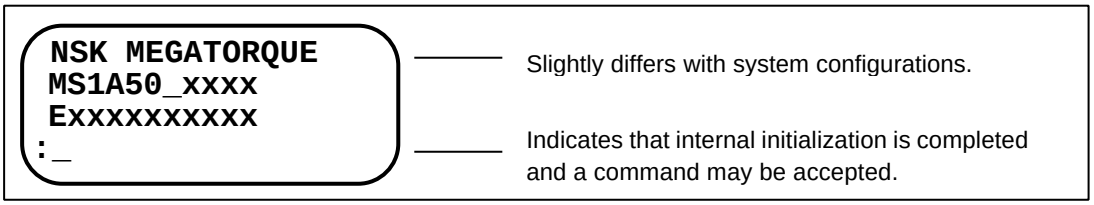
Caution : Always turn off the Driver Unit when plugging on/off the CN1 connector.

- ◊ Turn off the Driver Unit, if it has been turned on.
- ◊ Connect FHT11 and the Driver Unit at connector CN1.
- ◊ The communication will automatically begin when you turn on the control power of the Driver Unit.

7.1. When Power is Turned on

- If the terminal (NSK Handy Terminal FHT11) is connected to CN1 and the Driver Unit power is turned on, the message shown below is displayed.
- The contents (and the number of characters) of this message may differ with Driver Unit setting and system versions.
- When the Driver Units are initialized, a colon (:) is displayed and the system waits for a command to be entered. The colon (:) is called a prompt. If the colon (:) is not displayed, press ENT key.

Figure 7-1 : Power-On Message



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

7.2. Command Entry

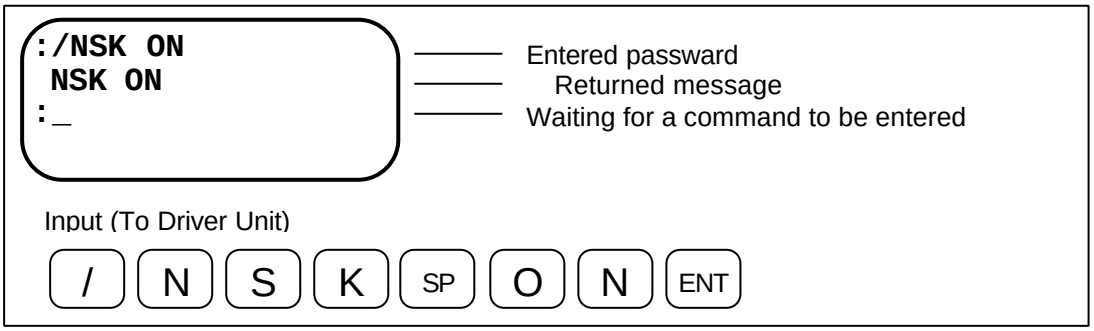
- Refer to “4.4. Handy Terminal” for the function of the keys.
- Communication command shall consist of “a command (character string) + data (if necessary) + [ENT]”
- If the velocity gain is to be set to 0.5, for example”VG0.5” should be entered by adding data of 0.5 to a VG command.
- Every time a character is input, the Driver Unit echoes the character back to the terminal. (The Driver Unit returns the same character it receives.)
- When [ENT] code is input, the Driver Unit decodes a character string which it has received (VG0.5 in the example above) and executes it. Therefore, a command is not executed unless it ends with [ENT] .

[Caution] : When turn off power of the Driver Unit, make sure that a colon (:) is displayed. If not, an alarm “Memory error” might be detected when you turn on the power next time.

7.2.1. Password

- Among the communication commands used for this System, some special commands (such as AB, PA, SI, etc.) require password entry for preventing erroneous entries. These commands cannot be entered in the same manner as other commands.
- The password is /NSK ON (a space between K and O) as shown below. If the Driver Unit accepts it, it returns an “NSK ON” message. Refer to “12. Command and Parameter” for details.
- A command that requires the password may only be executed immediately after it is entered.

Figure 7-2 : Password Input

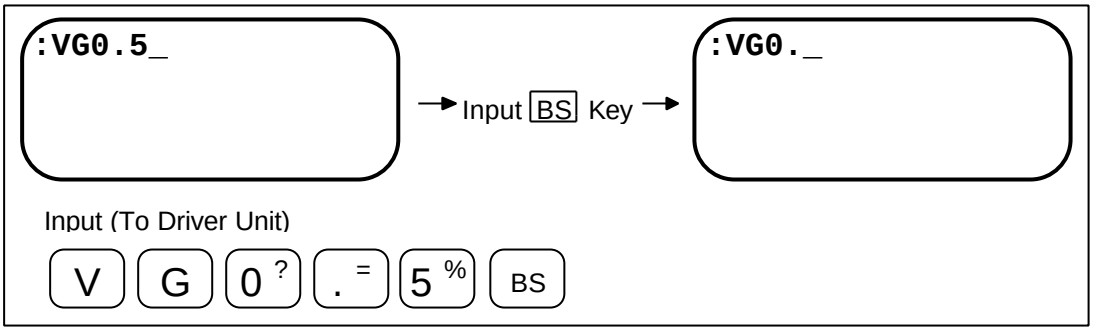


Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

7.2.2. Canceling Command

- To cancel a command which has been entered halfway, enter a backspace code.
- For example, when the backspace code is input following VG0.5, the cursor moves one space back to the position where 5 was input and thereby deletes 5.

Figure 7-3 : Canceling Example

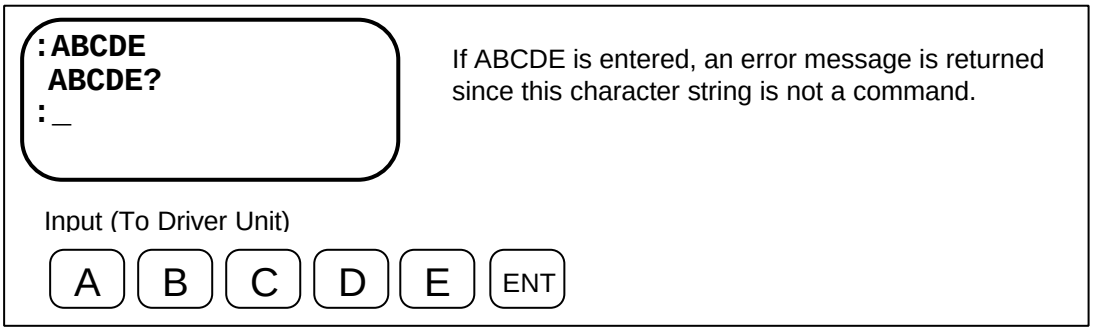


7.2.3. Error

- Note that an error occurs in any of the following cases:
  1) If a nonexistent command (i.e., character string) is entered.
     (If an entered character string cannot be decoded.)
  2) If data or subscript out of the allowable range is entered.
  3) If a command requiring the password is entered without the password.
- In any of these cases, the entered character string with a “?” mark is returned as an error message.

For example,

Figure 7-4 : Input Error Example 1



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

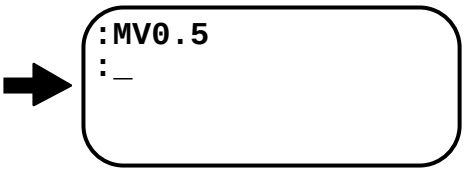
7.2.4. Entering Parameter

1) When entering parameter, make sure that a colon (:) is displayed on the screen.
(If the colon is not displayed, press the enter key once.)

ENT

2) As an example, set the parameter “Move Velocity MV” (revolution speed) to 0.5 r.p.s.
Enter the parameter as shown below.

M V 0 ? . = 5 % ENT



The colon (:) appears to confirm the entry.

- As shown above, inputting “the parameter command + numeric value + ENT key” completes the parameter entry. (Entering the space key between the parameter and numeric values is not necessary.)

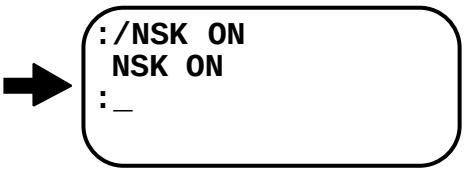
7.2.5. Parameter That Requires Entry of Password

1) When entering the command, make sure that a colon (:) is displayed on the screen.
(If the colon is not displayed, press the enter key once.)

ENT

2) Enter the password referring to “7.2.1. Password.”

/ N S K SP
O N ENT



The message confirming the entry of password is displayed and the colon (:) appears on the screen.

3) Enter the parameter as described in “7.2.4. Entering Parameter” above.
The parameters which requires entry of the password may only be executed immediately after the password is inputted.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

7.3. Readout Command

- If a command for reading out initial setting or current state is entered, the Driver Unit returns data.
- The following is an example for checking “Jog Velocity JV” set value.

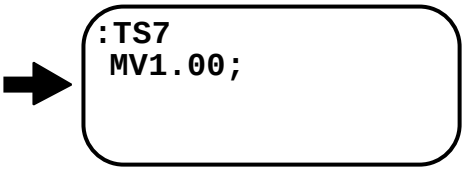
7.3.1. “TS” Command for Reading Set Value

1) When entering the command, make sure that a colon (:) is displayed on the screen.
(If the colon is not displayed, press the enter key once.)

ENT

2) Refer to “12. Command and Parameter.”
“JV” command is in the group of TS7, input

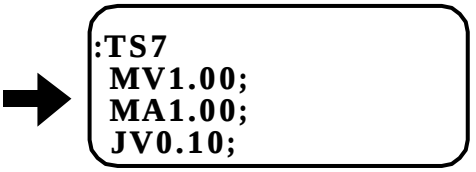
T S 7 ENT



The setting value of MV (Move Velocity) is displayed first.

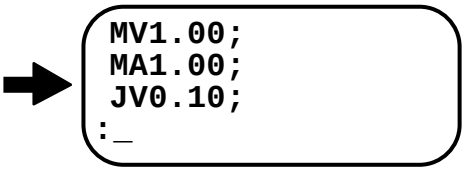
3) Press the space key to scroll display to find out JV value.

SP SP …



4) To finish the readout, keep pressing the space key until display stops scrolling or press the back space key.

BS



5) The colon (:) is displayed to indicate the system is waiting for next command.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

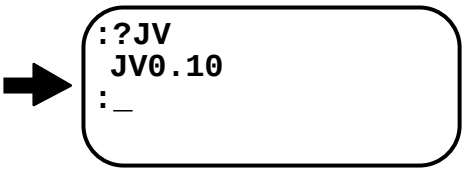
7.3.2. “?” Reading Function Command for Set Value

1) When entering the command, make sure that a colon (:) is displayed on the screen.
(If the colon is not displayed, press the enter key once.)

ENT

2) Enter “?” before inputting the command.
In case of this example, input “JV” after “?”.

? J V ENT



3) The colon (:) is displayed to indicate the system is waiting for next command.

Caution : When reading out set value, using TS command is recommended. When using “?” command, make sure to input “?” command before parameter characters. If not, and pressing ENT key after the characters may change the set value.

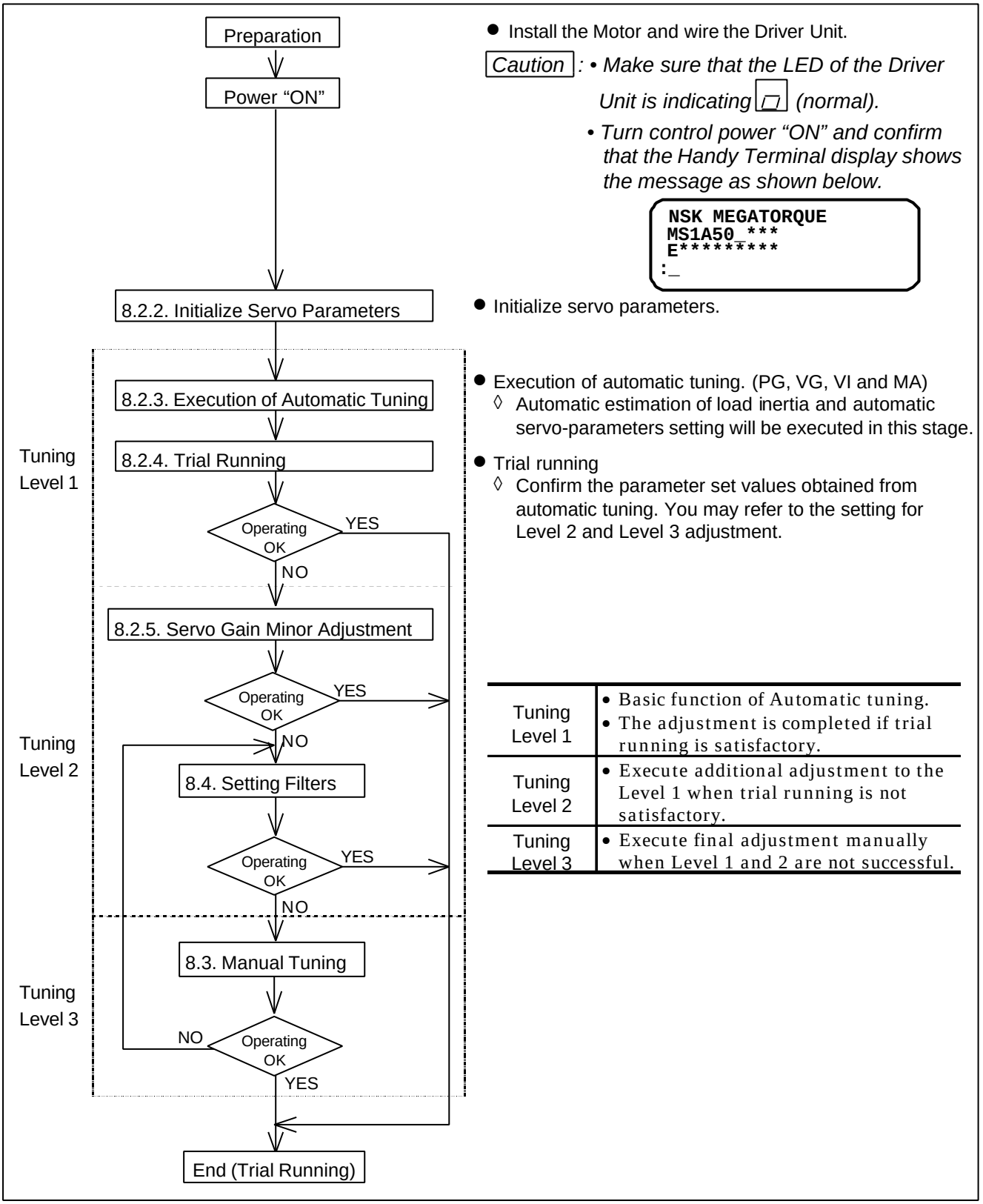
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

8. Tuning and Trial Running

- Gain adjustment is necessary for the position control mode and the velocity control mode.
- In the torque control mode, the noise filter adjustment may be required.

8.1. Tuning Procedure

Figure 8-1 : Tuning Procedure



- Install the Motor and wire the Driver Unit.

Caution : • Make sure that the LED of the Driver Unit is indicating ▱ (normal).

• Turn control power "ON" and confirm that the Handy Terminal display shows the message as shown below.

```
NSK MEGATORQUE
MS1A50_***
E*********
:_
```

- Initialize servo parameters.
- Execution of automatic tuning. (PG, VG, VI and MA)
  - ◊ Automatic estimation of load inertia and automatic servo-parameters setting will be executed in this stage.
- Trial running
  - ◊ Confirm the parameter set values obtained from automatic tuning. You may refer to the setting for Level 2 and Level 3 adjustment.

Tuning Level 1	• Basic function of Automatic tuning. • The adjustment is completed if trial running is satisfactory.
Tuning Level 2	• Execute additional adjustment to the Level 1 when trial running is not satisfactory.
Tuning Level 3	• Execute final adjustment manually when Level 1 and 2 are not successful.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

8.2. Automatic Tuning

Caution : *Automatic tuning cannot be performed if the following conditions are not met.*

- ◊ *The load inertia must be under the limit of the Motor. (Refer to "4.1. Motor Specification")*
- ◊ *The Motor axis must be vertical. (The load conditions to the Motor must not be affected by the gravity.)*
- ◊ *Mechanical rigidity of the Motor mounting base and attached load is sufficient enough.*
- ◊ *There must be no backlash or play caused by gears and couplings.*
- ◊ *Frictional load to the Motor shall be minimal.*

◆ Preparation

● Following preparation is required to execute the automatic tuning.

- ◊ Installation of the Motor.
- ◊ Attachment the load to the rotor of Motor.
- ◊ Installation of the Driver Unit.
- ◊ Wiring AC power line.
- ◊ Wiring the SVON (Servo on) and the EMST (Emergency stop). (CN2 connector)
- ◊ Connection of the Driver Unit and the Motor. (Use the optional cable set from NSK.)
- ◊ Connection of the Handy Terminal to the Driver Unit.

8.2.1. Precautions

Danger : *• Wire "EMST" (Emergency Stop, CN2) signal to stop the Motor immediately when an accident is foreseen.*

• If the Motor rotation range is restricted, set overtravel limits (OTP, OTM).

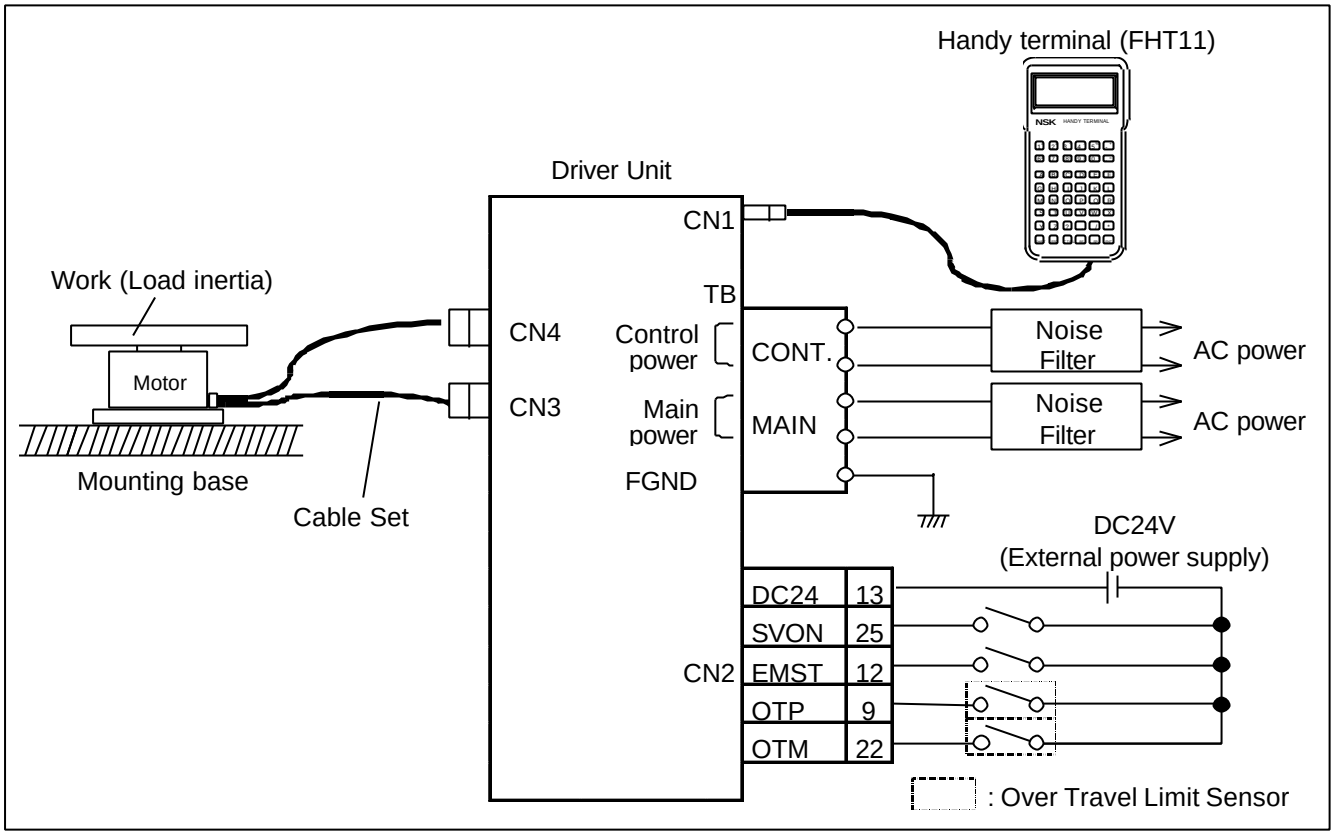
Danger : *The Motor rotates ±20° (degree) when executing automatic tuning. Always stay in safe position.*

Caution : *If mechanical rigidity of the load (work) is not sufficient enough, the Motor may vibrate. Turn "SVON" signal off or turn off the power when the Motor starts to vibrate. Execute manual tuning in chapter 8.3 or increase the rigidity of the load.*

Caution : *The automatic tuning is valid in the position control mode and the velocity control mode. It is not necessary for the torque control mode.*

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Figure 8-2 : Example: Wiring Diagram for Preparation of Automatic Tuning



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

8.2.2. Initialize Servo Parameters

1) Turn off the servo-on (SVON, CN2) signal.

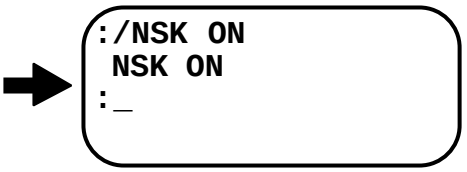
2) Enter

T S 1 # ENT and T S 2 $ ENT

to check the parameter settings. Note down all data.

3) Log in the password.

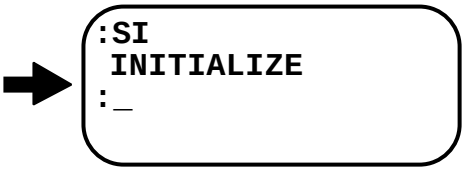
/ N S K SP
O N ENT



Display indicates the confirmation.

4) Log in SI (Set Initial Parameters) command.

S I ENT



"INITIALIZE" is displayed as the confirmation and the initializing parameter begins. It takes few seconds and a colon ":" is displayed for next command.

Caution : When "SVON" signal (CN2) is "ON" and "SI" command is input, Driver Unit rejects to execute the command. "SI INHIBITED" message will appear on the display.

Table 8-1 : Servo Parameter List

TS1 Reading			TS2 Reading		
Parameter	Initial Setting	Set Value	Parameter	Initial Setting	Set Value
PG	0.100		FO*	0.000	
VG	1.0		FP	0	
VI	1.00		FS	0	
VM	1		NP	0	
LG*	0		DBP*	0	
TL*	100		ILV*	100	
			FF*	0.000	
			FC*	0	

* These parameters are not necessary to adjust in Level 1 and 2 tuning.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

8.2.3. Execution of Automatic Tuning (Tuning Level 1)

Caution : *Make sure the work (or Motor) does not hit any obstacle when the Motor makes a full turn. Always stay in safe position.*

◊ *The Motor needs to rotate at least ±20° when executing the automatic tuning. If the application restricts the Motor rotation, keep room for ±20° Motor rotation. The overtravel limits (OTP, OTM) must be used to restrict the Motor rotation range.*

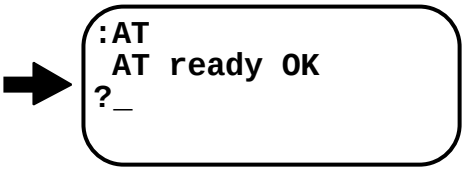
1) Turn SVON (CN2) signal "ON" and inputting "SV" command makes the Motor in servo-on state.

S V ENT

2) Confirm that Driver Unit's "LED" is indicating "▱" for normal condition.

3) Input "Automatic Tuning" command.

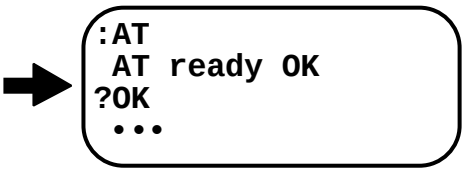
A T ENT



If a message is different from the display shown right, confirm procedures 1) and 2) again.

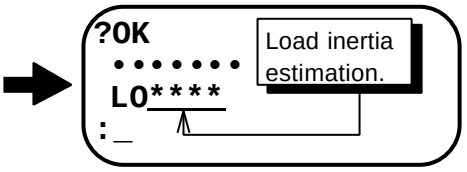
4) Confirm the message "AT ready OK" then input "OK."

O K ENT

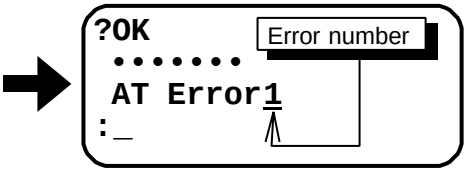


The Motor rotates 10~20° back and forth to estimate the load inertia. When executing estimation, a dot (.) keeps appearing in the display till the Motor stops.

5) After the estimation of load inertia, the display indicates the inertia value "LO."
(Way of displaying "." and the value of LO differ with the condition of load inertia.)



Caution : *When executing the automatic tuning, if an error message is "ON," refer to "14. Alarm" and take a proper remedy. Driver Unit's LED indicates "F8" for "AT" error in an example display shown right.*



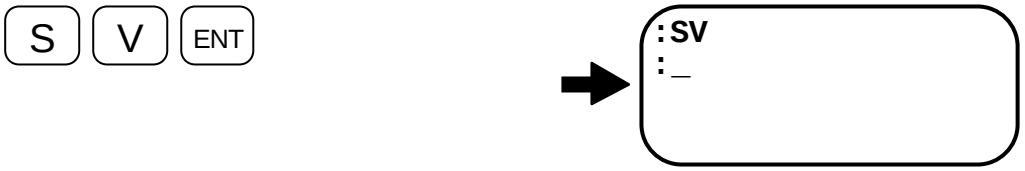
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

8.2.4. Trial Running (Tuning Level 1)

Danger : *Confirm that the work (or Motor) does not hit any obstacle when the Motor makes a full turn. Always stay in safe position.*

- For this adjustment, the demonstration program of ESA25 Driver Unit is used as an example. The program is originally set before it is shipped.

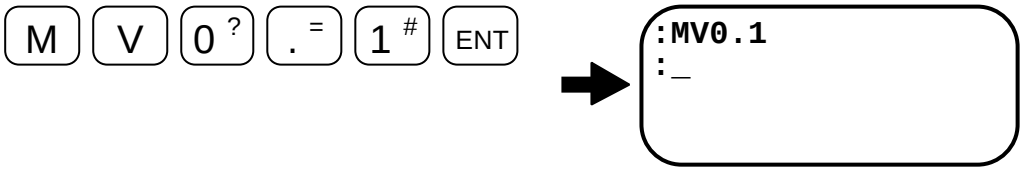
1) Turn SVON (CN2) signal "ON" and inputting "SV" command makes the Motor in servo-on states.



2) Confirm that Driver Unit's "LED" is indicating "▱" for normal condition.

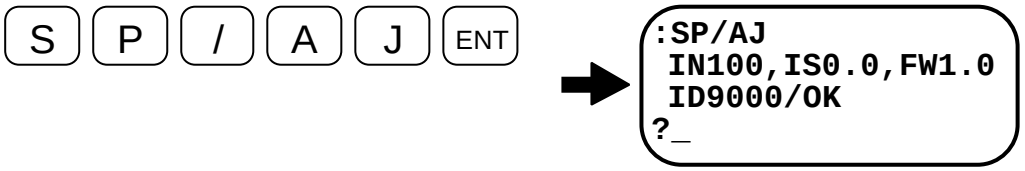
3) Confirm an emergency stop (EMST) and over travel limits (OTP, OTM) are "OFF".

4) After the automatic tuning the rotational speed "MV" has been initialized to 1 [s^{-1}].
Change "MV" to 0.1 s^{-1} for trial running.



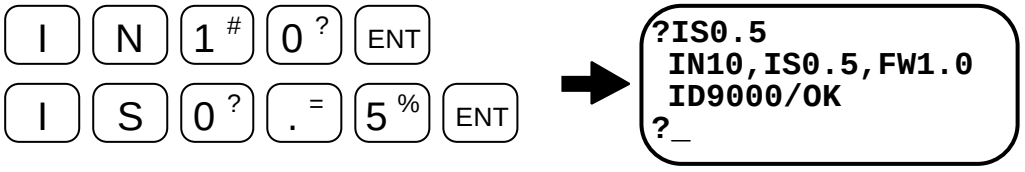
Note : After the adjustment, change "MV" to the actual use.

5) Display the demonstration program.



The message indicates the conditions of positioning and rotation angle.
IN: In-position, IS: In-position stability timer.
FW: FIN Width.
ID: Incremental Positioning, Degree.
(Refer to "12. Command and Parameter")

6) To make the adjustment simple, set IN "10" (pulse) and IS "50" [ms].

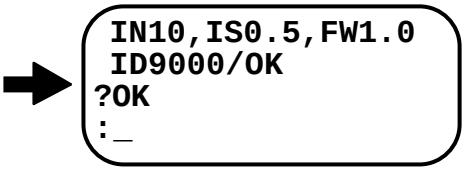


Check the display for confirmation.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

7) When rotational angle (ID) 9000 (90 degrees) is feasible, input “OK”.

O K ENT



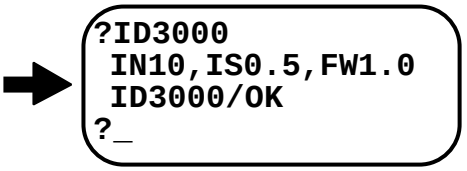
The motor starts the cycles as soon as “OK” is logged in.
(Firstly the Motor rotates clockwise (CW).)

- For changing rotational angle (ID) while “?” prompt is displayed, input desired ID without inputting “OK.”

8) To terminate the demonstration program input the command to display its menu screen. Press ENT key after “?” to get out the demonstration program.

◊ Example for rotational angle: 30° (degree)

I D 3 < 0 ? 0 ? 0 ?
ENT



9) When the trial running is completed, type

M S ENT

to stop the Motor.

- If the Motor is operating satisfactly, complete the trial running.
- When the Motor operation is not stable, try further adjustment in chapter 8.2.5 and 8.3.
- If you want to get out from the demonstration program, press the enter key after “? .”

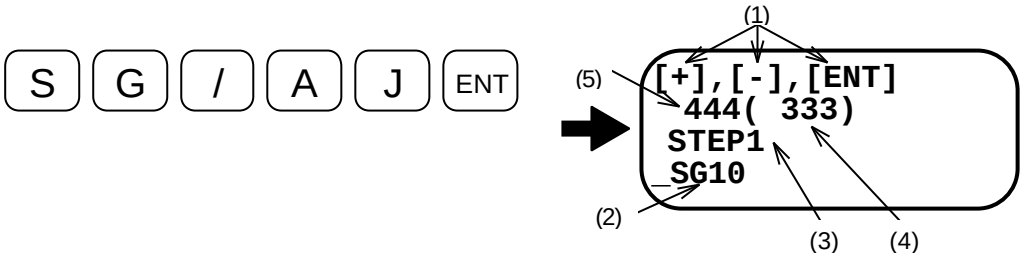
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

8.2.5. Servo Gain Minor Adjustment (Tuning Level 2)

Danger : *Confirm that the work (or Motor) does not hit any obstacle when the Motor makes a full turn. Always stay in safe position.*

- Perform minor adjustment of servo gain when the Automatic Tuning is not successful.
- Servo-gain can be adjusted by the parameter "SG."
  - ◊ Setting higher "SG" value improves response to the programmed motion profile. However, if "SG" is too high, the Motor tends to vibrate.
- The same demonstration program in chapter 8.2.4 is used as the example for adjusting "SG" value. (Follow the same procedures 1) ~ 7) in chapter 8.2.4 and keep operating the Motor.)

1) Start "SG" adjusting program.



The message is displayed as shown below. Press plus (+) or minus (-) key to change "SG" value. (The display shown above is an example. Those values shall be set to the conditions for actual use.)

- Explanation of the messages
  - (1) Key function

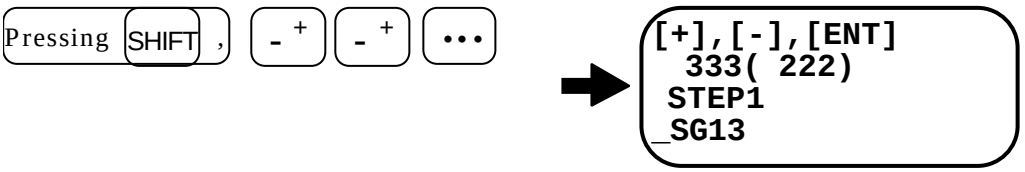
    SHIFT and - + : Pressing key one time increases 1 resolution of "SG."

    - + : Pressing key one time decreases 1 resolution of "SG."

    ENT : Store "SG" value to the memory.
  - (2) Indicates present "SG" value.
  - (3) Indicates "SG" value changed by pressing plus (+) or minus (-) key.
  - (4) Response index number: The lower numbers denotes better response.
  - (5) Positioning index number: The lower number denotes quicker response.

Caution : *Do not use space key or back space key. When it is used, the "SG" changing resolution ((2)) may be altered.*

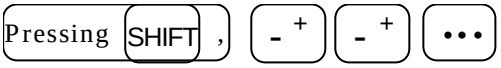
2) Observing the Motor operation, press the plus (+) key several times.

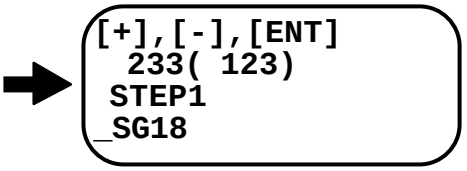


As the responce index decreases, the movement of the Motor is getting crisply.

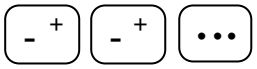
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

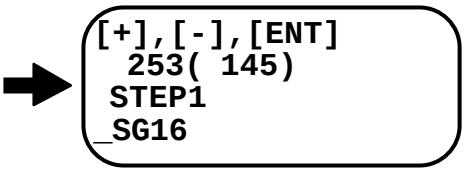
3) Keep pressing the plus (+) key, eventually the Motor starts hunting and stops.



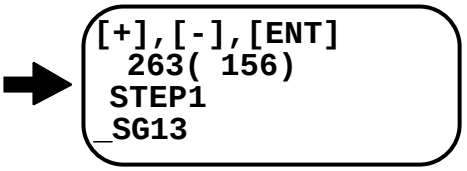


4) Keep pressing the minus (-) key until the Motor stops hunting and starts moving.

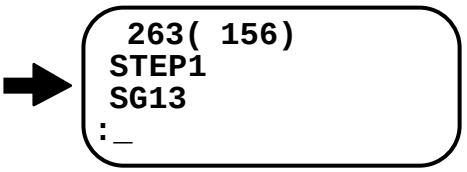




5) Set “SG” value to 80% of displayed “SG” when the Motor stopped hunting. The Motor oprates stable in any position.



6) Type the enter key to complete the adjustment.



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

8.3. Manual Tuning

Danger : *Confirm that the work (or the Motor) does not hit any obstacle when the Motor makes a full turn. Always stay in safe position.*

- Manual tuning is needed when the automatic tuning did not work.

8.3.1. Precautions

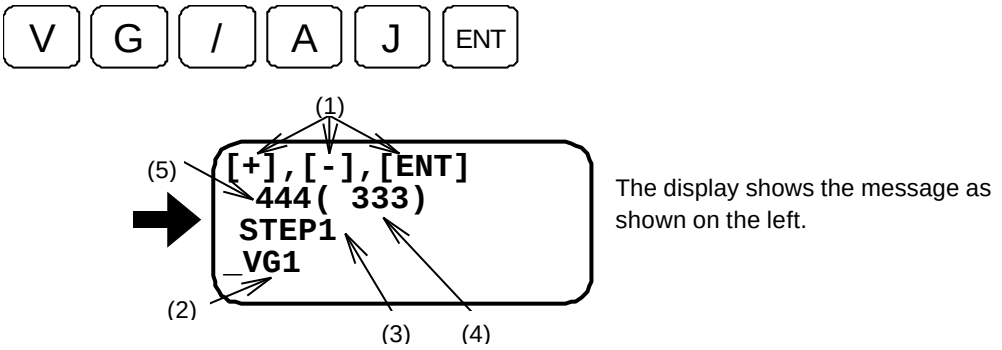
1) Initialize the servo parameters. Follow procedures in "8.2.2. Initialize Servo Parameters."

2) Execute the demonstration program referring to "8.2.4. Trial Running (Tuning Level 1)." It is not abnormal, though the Motor operation is unstable at the beginning due to insufficient tuning.

3) Input the command from the master controller when the control mode is the velocity control mode.

8.3.2. Adjustment of the Velocity Gain (VG)

1) Start "VG" adjusting program.



- Explanation of the messages

(1) Key function

SHIFT and - +	: Pressing key one time increases 1 resolution of "VG".
- +	: Pressing key one time decreases 1 resolution of "VG"
ENT	: Store "VG" value in the memory and completes the adjustment.

(2) Indicates present "VG" value.

(3) Indicates "VG" value changed by pressing plus (+) or minus (-) key.

(4) Response index number: The lower number denotes better response.

(5) Positioning index number: The lower number denotes quicker positioning.

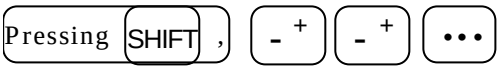
Caution : *Changing "VG" step ((2)).*
If you want to change the resolution of step, press space key or back space key.

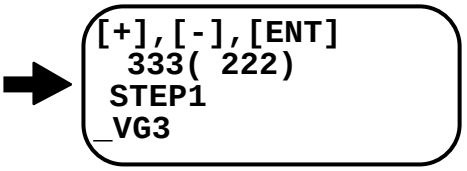
Space key : Changes the step to 1/10 of present resolution.
(Pressing twice makes 1/100.)

Back space key : Changes the step to 10 times of present resolution.
(Pressing twice makes 100 times.)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

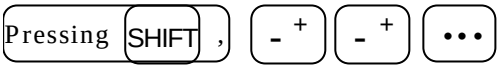
2) Observing the Motor operation, press the plus (+) key several times.

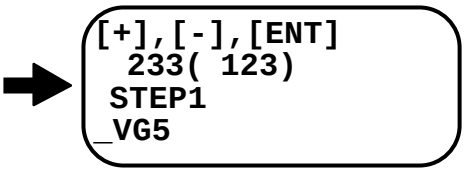




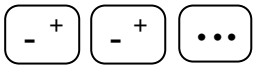
As the responce index decreases, the movement of the Motor is getting crisply.

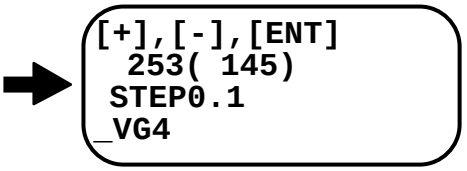
3) Keep pressing the plus (+) key, eventually the Motor starts hunting and stops.





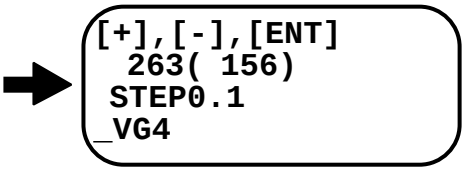
4) Keep pressing the minus (-) key until the Motor stops hunting and starts moving.



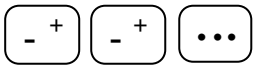


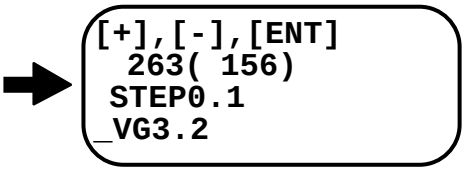
5) Set the “VG” value to 80% of displayed “VG” when a hunting is stopped.
$4 \times 0.8 = 3.2$

6) Press the space key to change the resolution of “VG” setting value from 1.0 to 0.1.

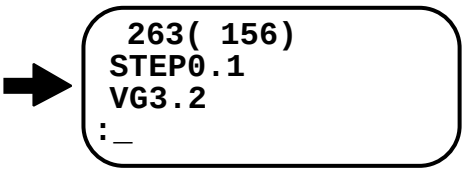


7) Press the minus key till “VG” value reaches to 3.2.





8) Press the enter key to store the “VG” value.



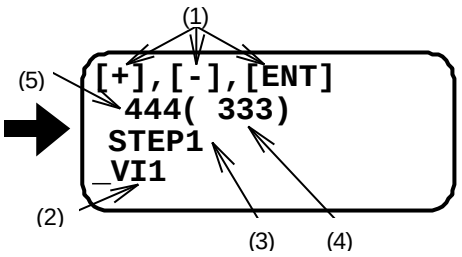
A colon (:) will appear to confirm the input.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

8.3.3. Adjustment of Velocity Integrator Frequency (VI)

- The adjustment of velocity integrator frequency (VI) shall be conducted after the velocity gain (VG) is adjusted.

1) Start "VI" adjusting program.



The messages are shown on the left.
Inputting the plus (+) or minus (-) key changes "VI" value.
(The "VI" value varries with an actual load inertia and revolution speed.)

- Explanation of the messages

(1) Key function

SHIFT and - + : Pressing key one time increases 1 resolution of "VI."

- + : Pressing key one time decreases 1 resolution of "VI."

ENT : Store "VI" value in the memory and completes the adjustment.

(2) Indicates present "VI" value.

(3) Indicates "VI" value changed by pressing plus (+) or minus (-) key.

(4) Response index number: The lower number denotes better response.

(5) Positioning index number: The rower number denotes quicker positioning.

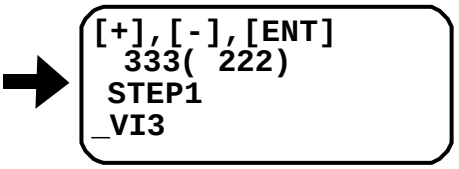
Note : Changing "VI" step ((3)).
If you want to change the resolution of step, press space key or back space key.

Space key : Changes the step to 1/10 of present resolution.
(Pressing twice makes 1/100.)

Back space key : Changes the step to 10 times of present resolution.
(Pressing twice makes 100 times.)

2) Observing the Motor operation, press the plus (+) key several times.

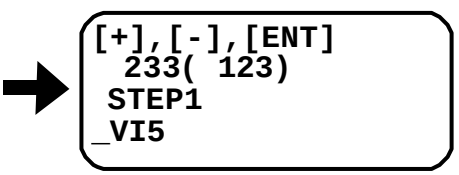
Pressing SHIFT , - + - + ...



As the responce index decreases, the movement of the Motor is getting crisply.

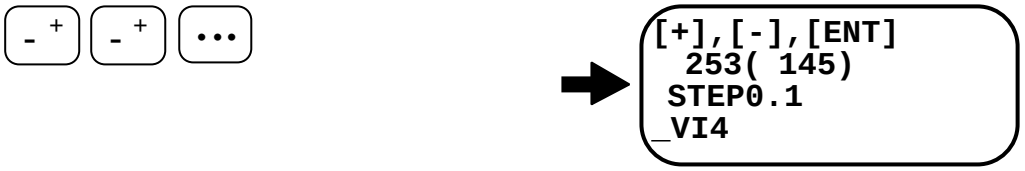
3) Keep pressing the plus (+) key, till the Motor starts hunting and stops.

Pressing SHIFT , - + - + ...



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

4) Keep pressing the minus (-) key until the Motor stops hunting and starts moving.

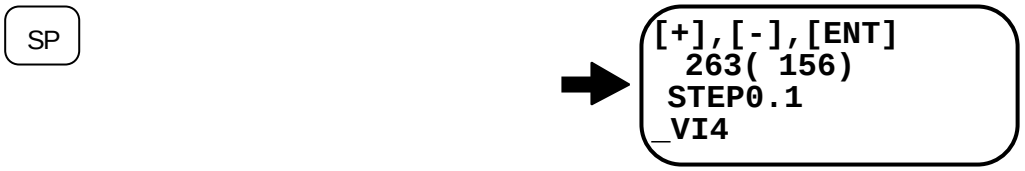


5) Set the “VI” value to 80% of displayed “VI” when a hunting is stopped.

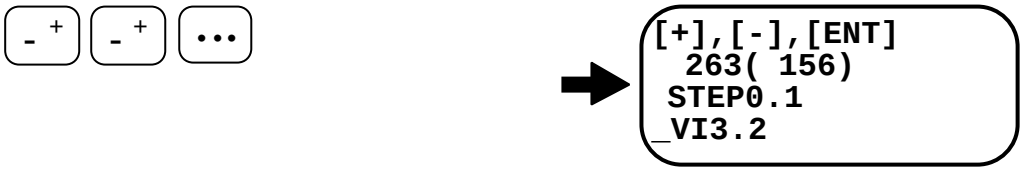
$4 \times 0.8 = 3.2$

Input the space key to change the resolution of “VI” setting value from 1.0 to 0.1.

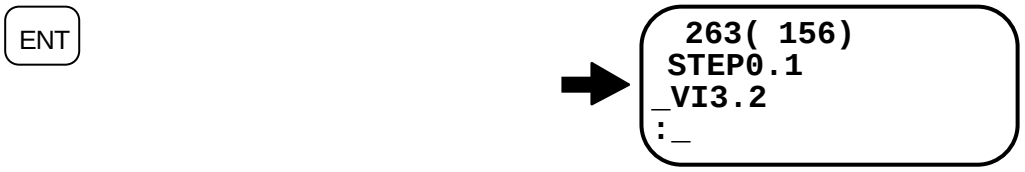
6) Press the minus key till “VI” value reaches to 3.2.



7) Input the enter key to store the “VI” value.



8) A colon (:) will appear to confirm the input.

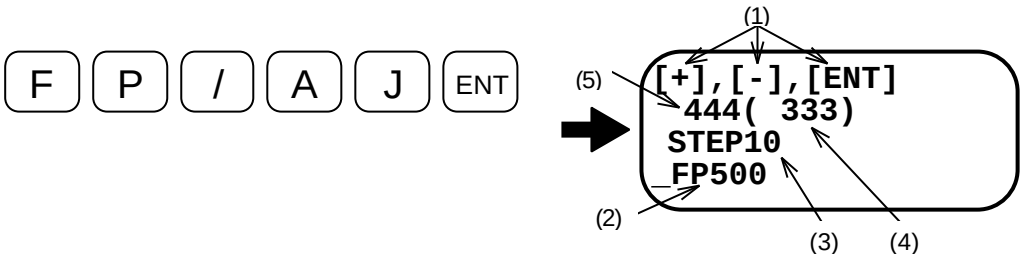


Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

8.4. Setting Filters (Tuning Level 2)

- The Motor may resonate mechanically and generate a noise of certain frequency when positioning. The noise may be reduced using a software of "low-pass filters" (parameter FP and FS) provided with the Megatorque Motor System. The unit of FP and FS is cycle / second (HZ).
  - ◊ If low frequency less than 100 HZ is set to parameters "FP" and "FS," hunting or unstable positioning may occur.
- Before using filters, make sure that all adjustments of gain (VG) and integrator frequency (VI) are completed.
- Use the same demonstration program (SA/AJ) for adjusting filters. Follow the procedures 1) ~ 7) in "8.2.4. Trial Running (Tuning Level 1)".
- When the system is used under the Torque or Velocity control mode, input the command from the external controller.

1) Start "FP" adjusting program.



The message is displayed as shown above. Press plus (+) or minus (key) to change "FP" value. (The display shown above is an example. Those values shall be set to the conditions for actual use.)

- Explanation of the messages
  - (1) Key function

    SHIFT and - + : Pressing key one time increases 10 resolution of "FP".

    - + : Pressing key one time decreases 10 resolution of "FP".

    ENT : Store "FP" value in the memory and completes the adjustment.
  - (2) Indicates present "FP" value.
  - (3) Indicates "FP" value changed by pressing plus (+) or minus (-) key.
  - (4) Response index number: The lower number denotes better response.
  - (5) Positioning index number: The lower number denotes quicker positioning.

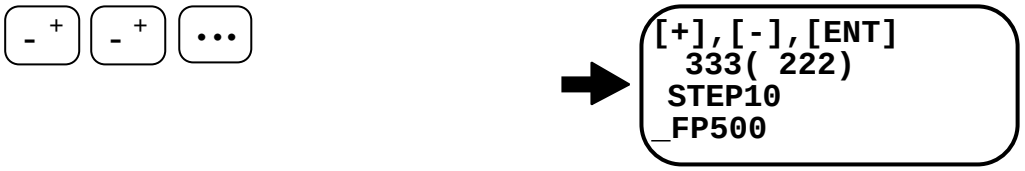
Caution *: Changing "FP" step ((3)).*
If you want to change the resolution of step, press space key or back space key

Space key : Changes the step to 1/10 of present resolution.
(Pressing twice makes 1/100.)

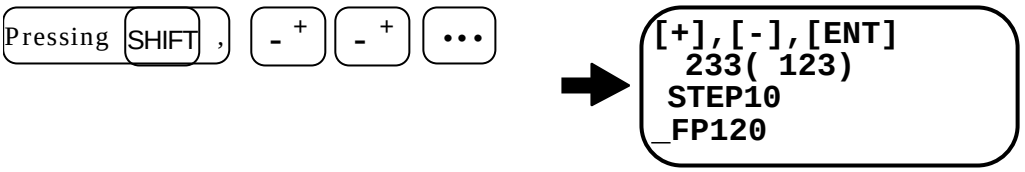
Back space key : Changes the step to 10 times of present resolution.
(Pressing twice makes 100 times.)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

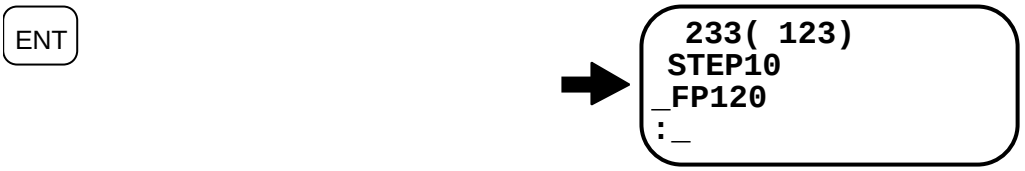
2) Decrease low-pass filter frequency (FP) to lower noise level by typing minus (-) key several times.



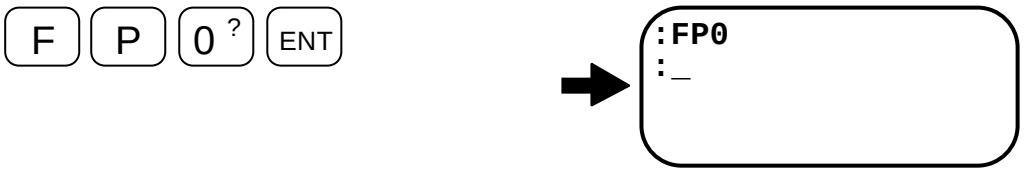
3) If the Motor starts to rotate unstably, increase “FP” value by typing plus (+) key several times.



4) Type the enter key to complete the adjustment.



Note : To deactivate the filter, input the filter command with “0” data. For example type as:



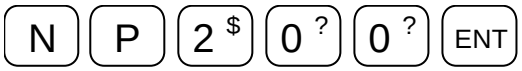
Note : Setting “Notch Filter”

◊ When setting notch filter, you can connect the ocsilloscope to monitor pins on Driver Unit front panel to know the resonance frequency.

• Example

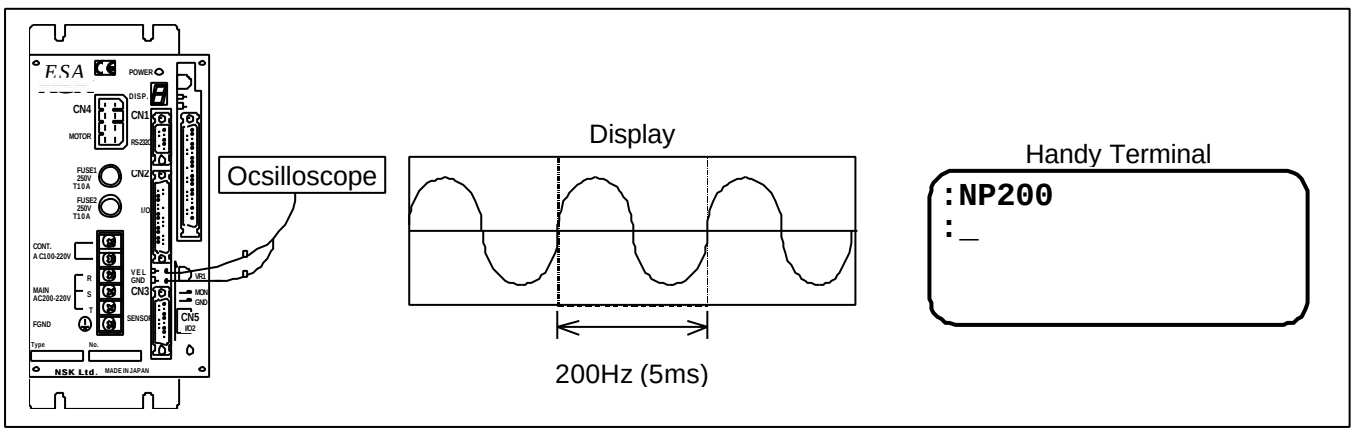
(i) Check the resonance frequency as shown in Figure 8-3.

(ii) If the resonance frequency is 200Hz, input



to set notch filter frequency.

Figure 8-3



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

(Blank Page)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

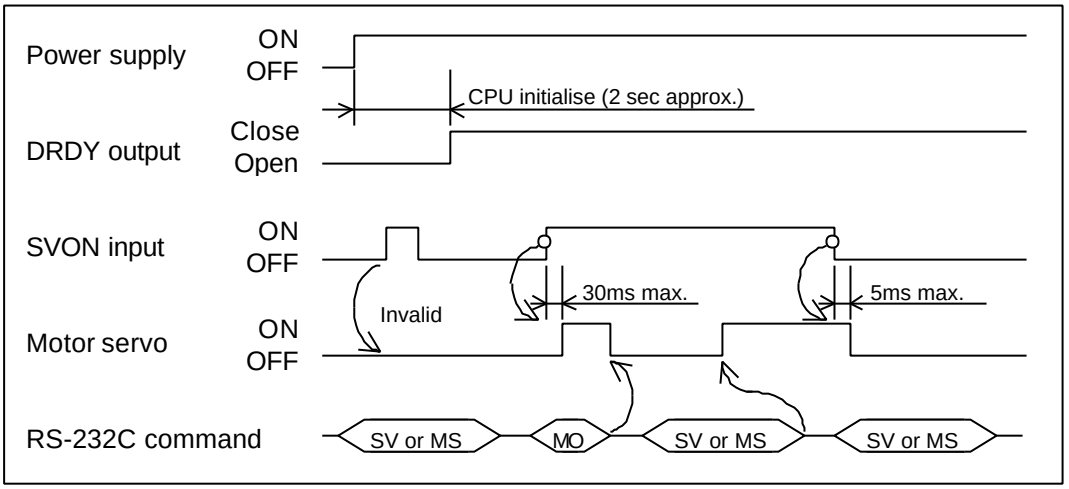
9. Operational Function

9.1. General Operation and Function

9.1.1. Servo “ON”

- After the power to Driver Unit is turned on and its DRDY output circuit is closed, making SVON input ON should make the Motor servo-on.
- The position error counter will be cleared when SVON input is OFF.
- When SVON input is ON, the “MO” command turns servo-off.
- The “SV” or “MS” command will cancel this “MO” command effect.

Figure 9-1

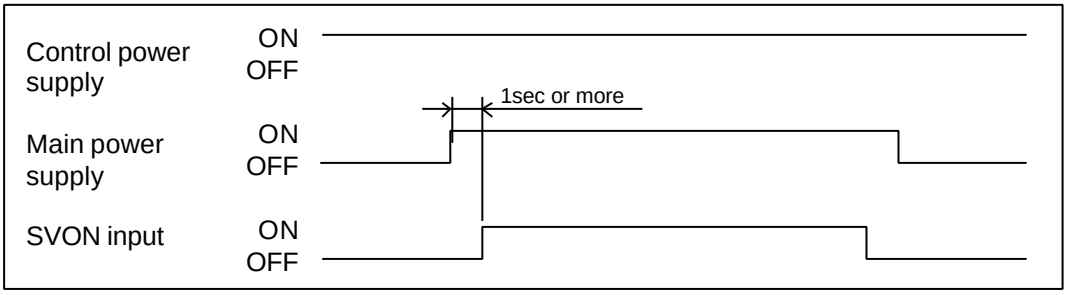


◆ Precaution when turning ON/OFF the main power supply and the control power supply separately:

- When turning on the main power supply with the control power supply turned on: Turn on the main power supply first, then the SVON input.
- When turning off the main power supply with the control power supply turned on: Turn off the SVON input first, then the main power supply.

* When the main power supply is turned off in the servo-on state, the Driver Unit outputs the AC Line under-voltage alarm. (Once this alarm occurs, it will not recover unless the power is turned on again.)

Figure 9-2



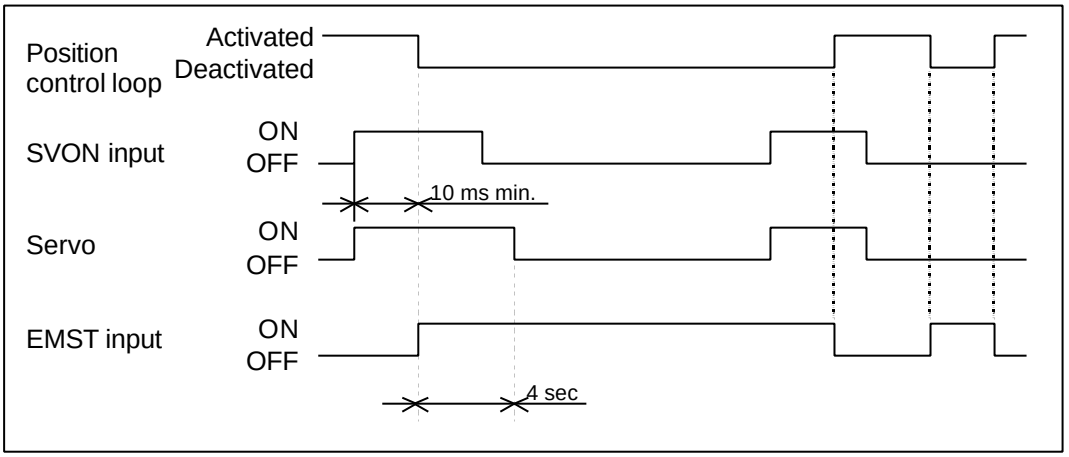
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

9.1.2. Emergency Stop

- Turning on the EMST input stops the position loop control function and stops the Motor in the servo-lock state* under velocity loop control.
- No motion commands will be accepted while EMST input is on.
- In the EMST state, the LED on the front panel indicates “F4”. The DRDY output remains unchanged (closed).
- The polarity of the EMST signal input port is set to A contact before shipment, but it can be changed to B contact (refer to the AB parameter).

* Provide a mechanical brake when an external force is applied to the Motor as the position loop control is not performed in this state. SERVO OFF cannot be established for 4 seconds after EMST input is ON even SVON input is OFF. Servo lock state won’t be established if SVON input is OFF at the moment of EMST input is ON.

Figure 9-3



◊ The Driver Unit may not accept EMST input unless it stays on for 10 ms or longer.

◊ The Motor gets in Servo lock state in velocity loop control for 4 seconds after EMST input is on even though SVON input is OFF.

◊ If the EMST input is ON while the main power is ON, the Motor gets in servo lock state for 4 seconds. However, if the main power is OFF simultaneous with or after the input of EMST, time for Servo lock state will be less than 4 seconds.

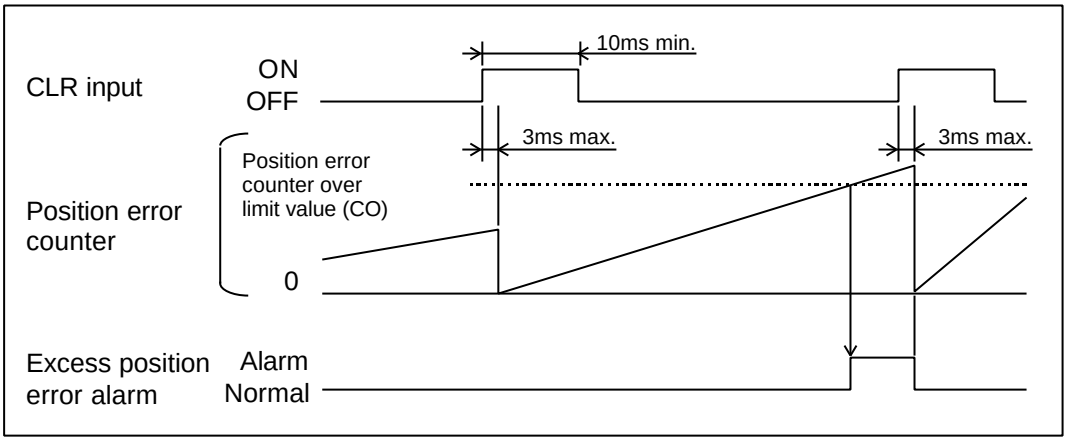
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

9.1.3. Clearing Position Error Counter

- CLR (clear) input clears the internal position error counter of position loop.
- When the excess position error alarm arises, turning on the CLR input clears the position error counter and recovers from the alarm state.

* The Driver Unit detects the rising edge of the CLR input signal and clears the position error counter to zero. Then, the counter continues its operation regardless of the state of the CLR input (even it remains on).

Figure 9-4

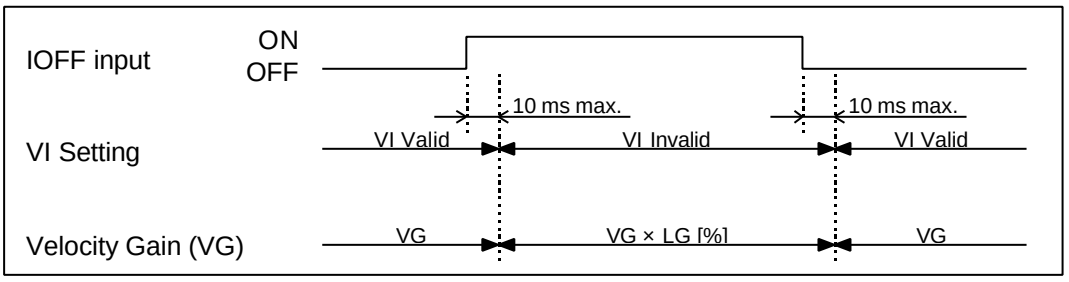


- Alarms for software thermal, velocity abnormal, program error, RS-232C abnormal and automatic tuning error may be cleared by CLR input. (Other alarms cannot be cleared by CLR input.)

9.1.4. Integration off (IOFF)

- Parameter VI (Velocity Integrator Frequency) will be invalidated when IOFF input is activated. Simultaneously, VG (Velocity Gain) will be lowered according to LG (Gain lowering coefficient) setting. (VG × LG)
- VI is validated when IOFF input is turned off.

Figure 9-5



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

9.1.5. Over-travel Limit Switch

9.1.5.1. Hardware Over-travel Limit Switch

- Use the OTP and OTM inputs to restrict the range of Motor rotation.
- If the OTP input is activated, the Motor will stop immediately and remain in servo-on. The Motor can rotate in counter clockwise only.
- If the OTM input is activated, the Motor will stop immediately and remain in servo-on. The Motor can rotate in clockwise only.

* The polarity of the OTP and OTM input ports is set to A contact before shipment. It can be changed to B contact. (Refer to the section of the AB parameter)

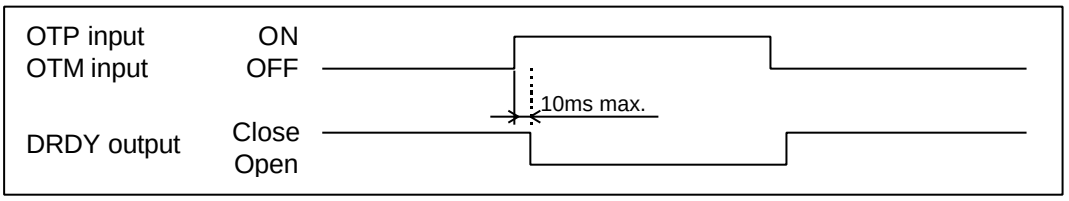
* Besides the OTP and OTM inputs, the Motor rotation can also be limited by software (software over-travel limit function) in the Driver Unit. Refer to "9.1.5.2. Software Over-travel Limit Switch."

  ◊ When over-travel error occurs, the DRDY output will be open and LED on the front panel indicates the following alarms.

  OTP or OTM limit : F3

  Software over-travel limit : F2

Figure 9-6



* When the OTP or OTM input works in the middle of Home Return operation, the Motor completes the Home Return operation after performing the following:

1 When the Motor is turning to CCW

Caution : • The OTP input is invalid (the Motor continues rotation).

• Turning on the OTM input stops the Motor immediately.

2 When the Motor is turning to CW

Caution : • Turning on the OTP input stops the Motor immediately.

• The OTM input is invalid (the Motor continues rotation).

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

9.1.5.2. Software Over-travel Limit Switch

Notes to be taken in over-travel limit setting

Caution : *• The over-travel area should be 1000 [pulses] or wider. When the over-travel area is too narrow the Motor may turn through the "off-limits" area.*

• Set the over-travel limits with ample margin, giving consideration to the overshoot of the mechanism controlled by the Motor.

• When "off-limits" area is specified by the software over travel limit, the Motor rotates to the direction to avoid off-limit area regardless of moving distance. (Commands AD and AR is disregarded, even it is set.)

- This function becomes valid after the Home position is determined by Home Return or AZ command.
- Use the OTP and OTM commands to set the over-travel limit values.

<Operation> Setting by teaching

1) Turn off the Motor servo.

M O ENT

```
:MO
:_
```

2) Move the Motor's rotor manually to a point to be the over-travel limit on the plus side.

3) Input the password.

/ N S K SP
O N ENT

```
:MO
:/NSK ON
 NSK ON
:_
```

4) Register the present position as the over-travel limit on the plus side. The registered over-travel limit value appears on the display.

O T P / S T
ENT

```
:OTP/ST
 OTP123456
 OTM0
:_
```

5) Move the Motor's rotor manually to a point to be the over-travel limit on the minus side.

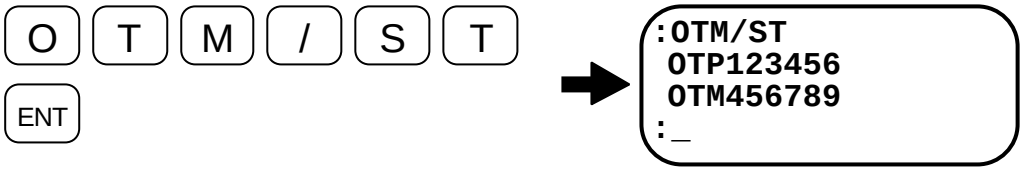
6) Input the password.

/ N S K SP
O N ENT

```
:MO
:/NSK ON
 NSK ON
:_
```


Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

7) Register the present position as the over-travel limit on the minus side. The registered over-travel limit value appears on the display.



8) Move the Motor's rotor into the over-travel area. Check that the Driver Unit outputs the F2 alarm. (Check the alarm indicated on the LED or input the TA command)

- If the F2 alarm is not output this time, check the following:
  - ◊ Is the home position between OTP and OTM?
  - ◊ In the single rotation position scale: Is OTP < OTM?
  - ◊ In the Linear position scale: Is OTP a positive value? OTM a negative value?

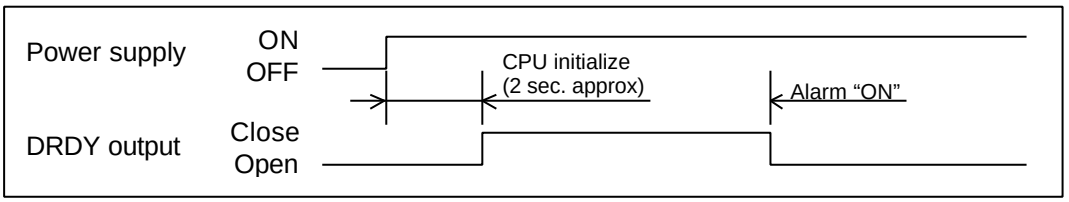
Setting by position scale data

- When the over-travel limit values are already known, user can directly set these values to the OTP and OTM command parameters.

9.1.6. Alarm Output

- After the power is on and "CPU" is initialized, "DRDY" output is closed when alarms are not reported.
- The "DRDY" output opens when the alarm is detected.
- Alarm signal shall be connected to "alarm input" of the master controller.

Figure 9-7

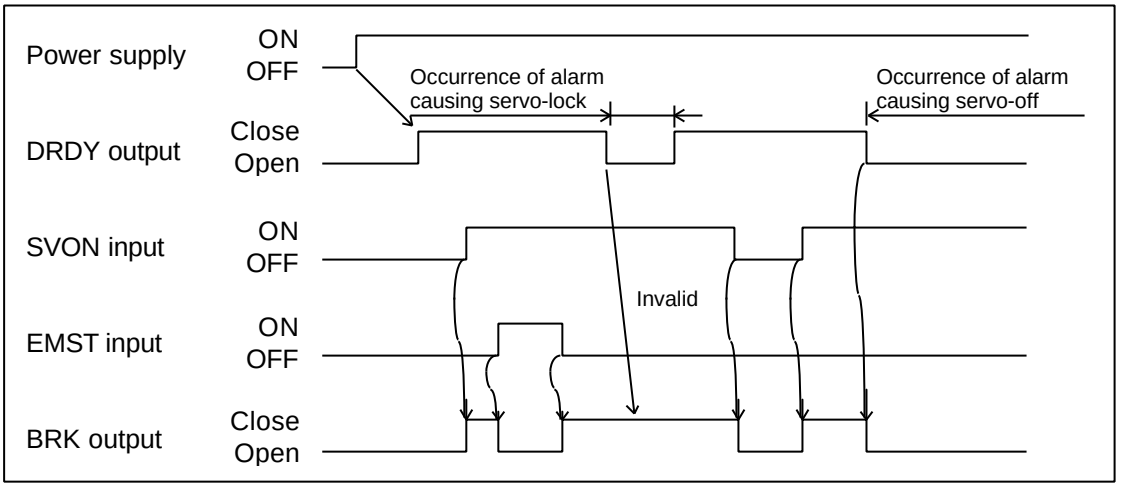


Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

9.1.7. Brake Signal Output

- The BRK output opens in the following states:
  1) SVON input : OFF
  2) Occurrence of an alarm which makes the Motor servo to turn off (example : memory error, etc.).
  3) During system initialization after the power is turned on
  4) EMST input : ON

Figure 9-8



* This signal can be used to control negative (normally on) brake, which activates the external brake when the Motor servo goes off or the EMST is input.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

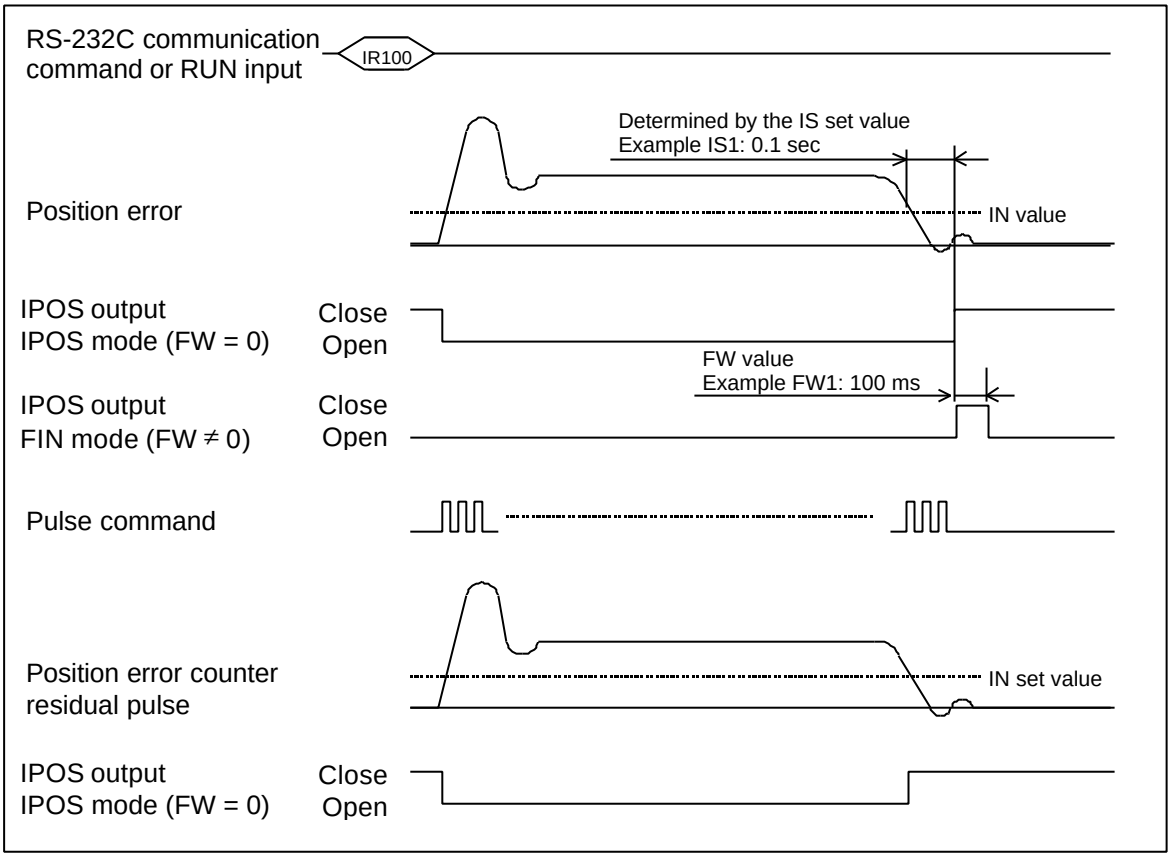
9.1.8. In-Position Output

- In-Position output condition is determined by the following parameters.

Table 9-1

Parameter	Function (Name)	Shipping set
FW	IPOS outputting time range (Output mode)	FW1
IN	In-Position limit value	IN100
IS	In-Position stability timer	IS0

Figure 9-9



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

9.1.8.1. Output Signal Format

- The output signal format · · · either IPOS format or FIN format · · · can be selected by setting the FW parameter.
  - ◊ FW data : FIN format is selected when data ≠ 0 (shipping set : FW1)
  - ◊ FW0 : IPOS format

1 When data of parameter "FW" is not "0" (Zero) (FIN mode)

- "IPOS" output indicates that the positioning has completed.
- IPOS will be output for every positioning start command such as RUN and HOS .
- Out put state
  - ◊ IPOS output is always open and it closes only for the moment set by "FW" when the positioning completes (The unit of closing time in "FW" is 100m sec. Shipping set FW1 : 100m sec.)

Recommendation

We recommend to use FIN mode when you use the programmable indexer in the Driver Unit.

- "IPOS" will not be output for pulse train operation and jog operation.
- When the positioning is disturbed in the middle of operation by the emergency stop or over-travel limit switch, "IPOS" will not be output.

2 When "data" of parameter "FW" is 0 (Zero) (IPOS mode)

- The format is to indicate if there is a difference between position command and current position.
- Basically "IPOS" output will be closed only when residual pulses in the position error counter is within the range set by "IN" parameter. In other state, it is open.
- However, even residual pulses in the position error counter is within the "IN" value, output is forced to open during pulses are generated internally when executing programmable indexer, Home Return, jog and operations via the RS-232C communication.

Recommendation

Select "IPOS" mode for pulse train command operation or a positioning via the RS-232C communication.

- When the positioning is disturbed in the middle of the operation by emergency stop or over-travel limit signal, IPOS output will stay closed if residual pulses of position error counter are within the "IN" value.
- When executing pulse train command operation, even pulses are being input, IPOS output is closed if residual pulses in the position error counter are within "IN" value.

  [This state tends to occur when executing low speed operation or feed forward compensation is applied ("FF" parameter).]

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

9.1.8.2. Parameter “IN”

- Parameter “IN” is to decide positioning accuracy.
- “IPOS” output will be closed when residual pulses of position error counter are within the range of “IN” parameter.
- The unit of parameter “IN” value is the maximum resolution (pulses) of the motion detector (resolver).

Table 9-2 *[Unit: pulse/r]*

Motor series	Resolution
YS, JS1, JS2, RS	614 400
SS	491 520
AS, BS, JS0	409 600

◆ Example (YS series)

- Desired positioning accuracy (repeatability) : ±100 sec.

$$\text{“IN” set value} = \frac{\text{resolver resolution}}{360} \times \text{repeatability (degree)}$$

$$= \frac{614\,400}{360} \times \frac{100}{3\,600}$$

$$= 47 \text{ pulses}$$

9.1.8.3. Parameter “IS”

- “IS” is to confirm the stability of the positioning. In case of in-position output signal is IPOS format, if the parameter “IN” value is smaller (roughly less than IN10), “IPOS” output will be instable in a moment of positioning settling, even all the servo gains are adjusted properly.
- “IS” parameter should be set to eliminate above instability.
- When “IPOS” output is in “FIN” mode, “IS” parameter prevents to output IPOS signal before the Motor completes the positioning.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

9.1.8.4. “IPOS” Output in Special Occasion

1 When 0 (Zero) movement operation is executed.

◆ **Example**

When [AD0] or [AR0] is executed even the Motor is in the Home position, movement of the Motor is 0 (Zero). Followings show “IPOS” output states in such a case.

1) “IPOS” mode IS = 0

- ◊ There is no internal pulse output and “IPOS” output remains close if residual pulse of position error counter are within “IN” value.

2) “IPOS” mode IS ≠ 0

- ◊ Even no pulse is internally generated, “IPOS” output will be opened for the moment set by “IS” value to check positioning stability.

3) “FIN” mode

- ◊ Even no pulse is generated internally, “IPOS” output signal shall always be returned for positioning start command.

2 Sequential operation* for Programmable Indexer.

1) “IPOS” mode

- ◊ After the positioning is completed, execute next channel program, while “IPOS” output remains open.

2) “FIN” mode

- ◊ After the positioning is completed, “IPOS” output closes for the moment which is set by the parameter “FW,” then execute the next channel’s program after “IPOS” output is opened again.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

9.1.9. Position Feedback Signal

◆ Resolution

- Set the øA/øB resolution using the FR parameter (via RS-232C).

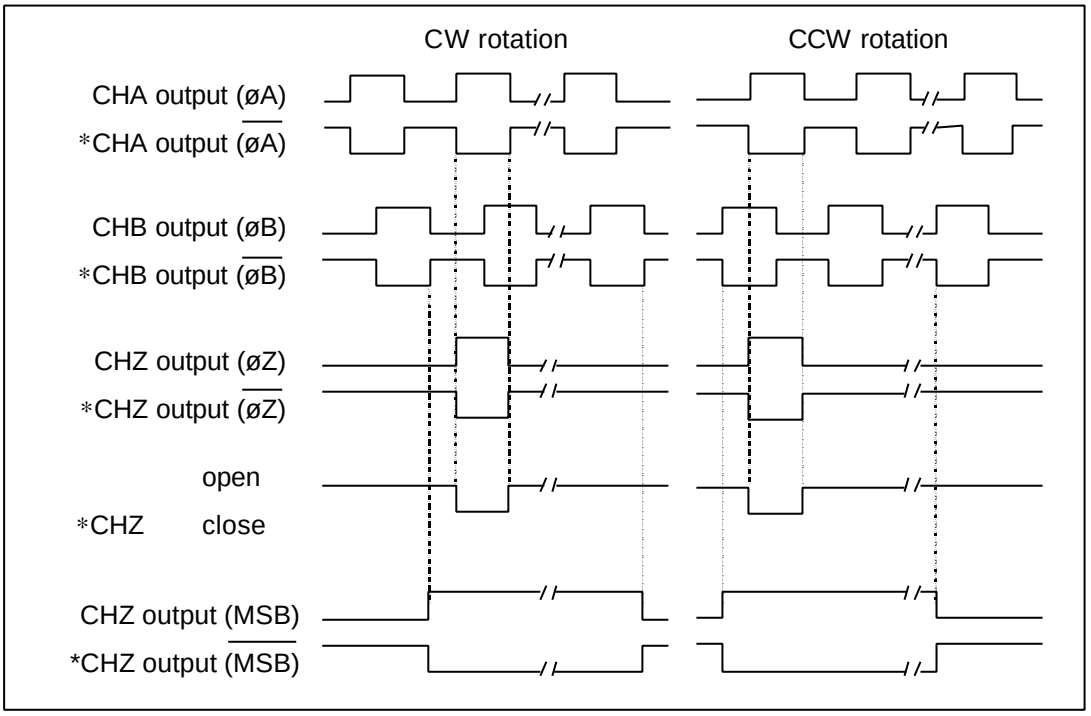
Table 9-3 *[Unit: pulses/rotation]*

Feedback signal / Motor series	øA, øB		øZ
	FR1	FR0	
YS, JS1, JS2, RS	153 600	38 400	150
SS	122 880	30 720	120
AS, BS, JS0	102 400	25 600	100

* When the resolver resolution is set to the automatic resolution switching or 10-bit setting, set the FR parameter to FR0. When it is set to FR1, øA/øB will not be output.

◆ Output timing

Figure 9-10



* The phase can be reversed by the FD parameter (set via RS-232C).
  FD0 : Standard ; at CW rotation, leading phase øA
  FD1 : Reverse ; at CW rotation, leading phase øB

* The output specification of the CHZ signal--whether to output øZ or MSB--is selected by the FZ parameter (set via RS-232C).
  FZ0 : øZ
  FZ1 : MSB

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

9.1.10. Monitor Functions

- The Motor operation can be monitored by using the analog velocity monitor pins, which are provided in the front panel of Driver Unit, and RS-232C communication.

Table 9-4

Item	RS-232C communication command	Monitor output	Description
Velocity	–	VELOCITY check pin on the front panel	• Monitors the Motor velocity in forms of analog voltage output.
Position error	TE	CN1 via RS-232C terminal	• Monitors value of the position error counter. • For the details, refer to “12. Commands and Parameter.”
Input/output	IO		• Monitors the input/output status (on/off) of CN2. • For the details, refer to “12. Commands and Parameter.”
Current position	TP		• Monitors the current position in the absolute position scale. • For the details, refer to “12. Commands and Parameter.”
Parameter value	TS		• Monitors the set values of parameters. • For the details, refer to “12. Commands and Parameter.”
Alarm	TA		• Monitors the alarm status. • For the details, refer to “14.1.2. Using TA Command.”
Channel program	TC		• Monitors the program stored in the channels. • For the details, refer to “12. Commands and Parameter.”
Analog monitor	MN	Front panel MON (GND) terminal	• Motor velocity and residual pulses of the position error counter may be monitored in analog data.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

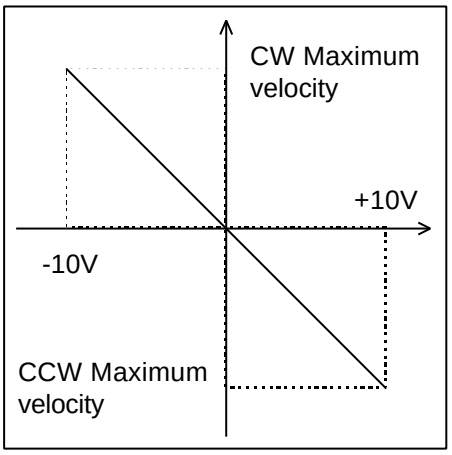
9.1.10.1. Velocity Monitor

- The user can monitor the velocity of the Motor by measuring the voltage between VELOCITY and GND check pins on the front panel.

◆ When the resolver is set to 12-bit resolution

Note : ±10 V is only a typical value; actual values vary slightly. The voltage is not a precise representation of the velocity.

Figure 9-11



◆ When the resolver is set to 10-bit resolution or automatic resolution switching

Note : ±7.5 V is only a typical value; actual values vary slightly. The voltage is not a precise representation of the velocity.

Figure 9-12

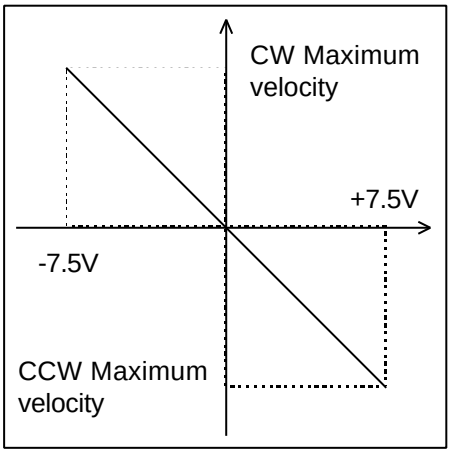


Table 9-5: Maximum velocity *[Unit: s^{-1}]*

Resolver resolution / Motor series	12-bit setting	Automatic resolution switching or 10-bit setting
YS, JS1, JS2, RS	1	3
SS	1.25	3.75
AS, BS, JS0	1.5	4.5

- Automatic resolution switching, 12-bit setting and 10-bit setting are selected by the RR parameter.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

9.1.10.2. Monitoring I/O State (IO)

- The Input/Output signal status of CN2 and CN5 connectors can be monitored using “IO” command.

- This is useful to check the wiring.

  ◊ Input format

  IO0/RP : Monitor I/O state

  IO2/RP : Monitor the I/O related to programmable indexer

  IO3/RP : Monitor the I/O related to Jog operation

Note : /RP is to set the frequency of the monitoring.

Without /RP : One-shot monitoring

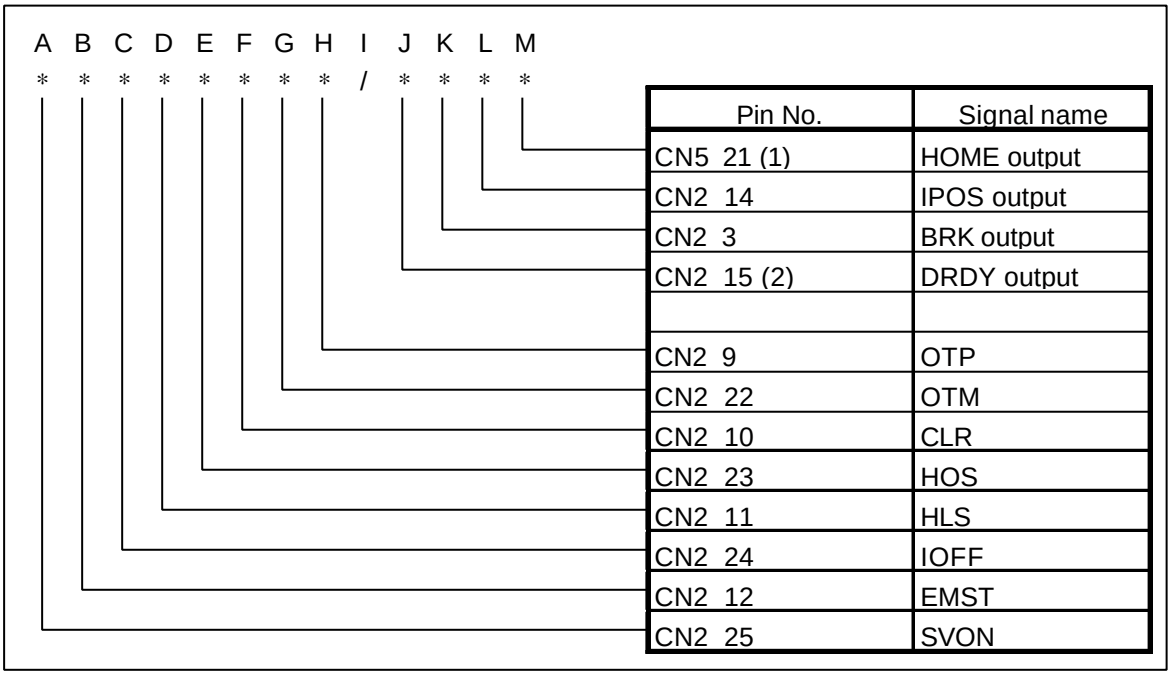
With /RP : Real-time monitoring (Repeats monitoring)

◊ Display format

Bit map representing Input/Output in 1 line (See Figure 9-13 to 9-15.)

- The status is displayed on the Handy Terminal screen.

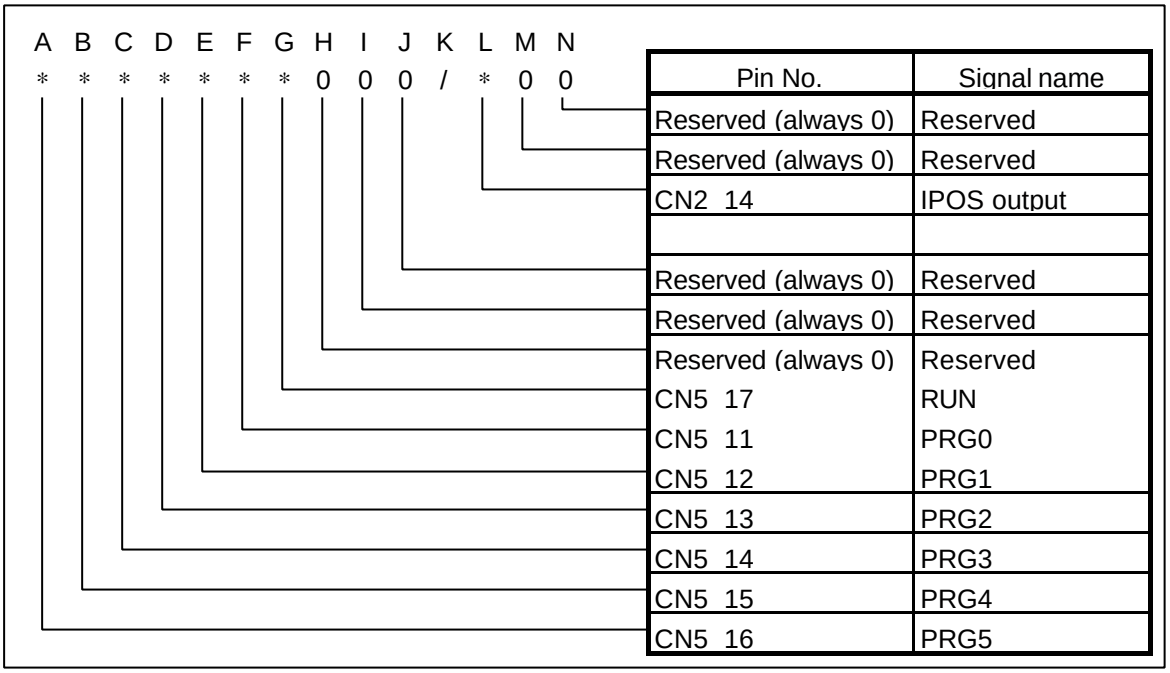
Figure 9-13: IO0/RP (Monitor I/O state)



Pin No.	Signal name
CN5 21 (1)	HOME output
CN2 14	IPOS output
CN2 3	BRK output
CN2 15 (2)	DRDY output
CN2 9	OTP
CN2 22	OTM
CN2 10	CLR
CN2 23	HOS
CN2 11	HLS
CN2 24	IOFF
CN2 12	EMST
CN2 25	SVON

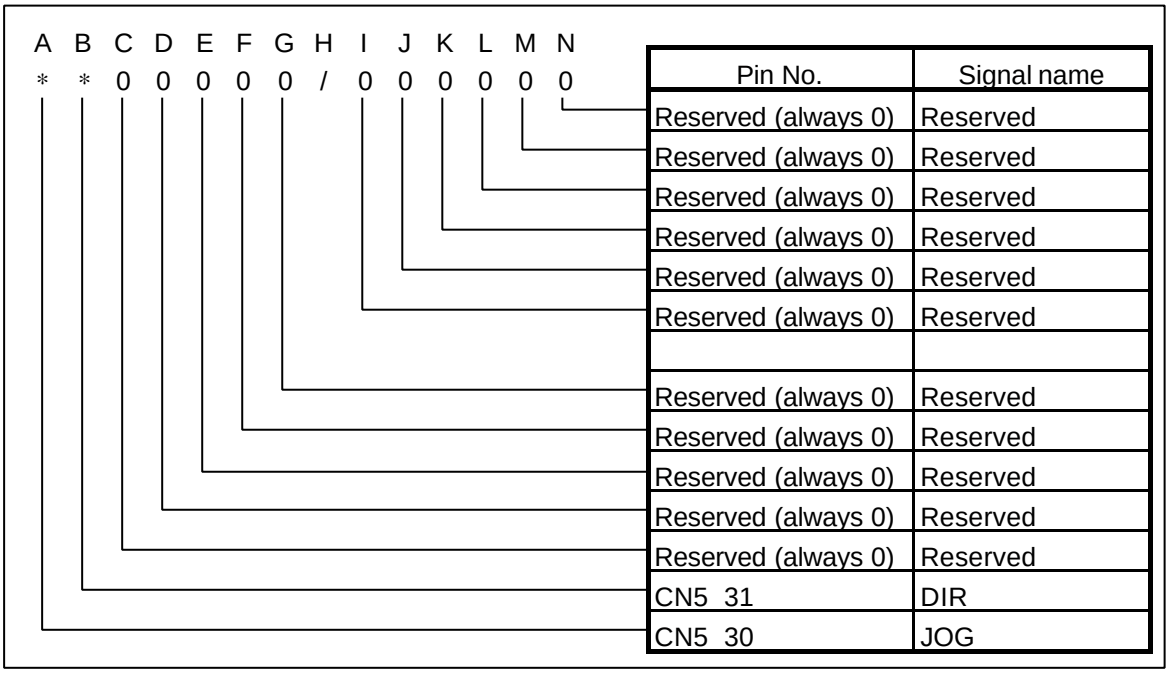
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Figure 9-14: IO2/RP (Monitor I/O related to programmable indexer)



Pin No.	Signal name
Reserved (always 0)	Reserved
Reserved (always 0)	Reserved
CN2 14	IPOS output
Reserved (always 0)	Reserved
Reserved (always 0)	Reserved
Reserved (always 0)	Reserved
CN5 17	RUN
CN5 11	PRG0
CN5 12	PRG1
CN5 13	PRG2
CN5 14	PRG3
CN5 15	PRG4
CN5 16	PRG5

Figure 9-15: IO3/RP (Monitor the I/O related to Jogging operation)

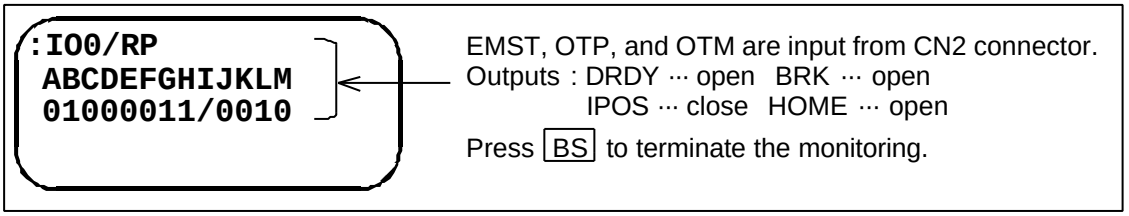


Pin No.	Signal name
Reserved (always 0)	Reserved
Reserved (always 0)	Reserved
Reserved (always 0)	Reserved
Reserved (always 0)	Reserved
Reserved (always 0)	Reserved
Reserved (always 0)	Reserved
Reserved (always 0)	Reserved
Reserved (always 0)	Reserved
Reserved (always 0)	Reserved
Reserved (always 0)	Reserved
Reserved (always 0)	Reserved
CN5 31	DIR
CN5 30	JOG

Table 9-6: Meaning of display data

	Display: 1	Display: 0
Input port	ON	OFF
Output port	Close	Open

Figure 9-16: Example of monitoring


:IO0/RP
ABCDEFGHIJKLM
01000011/0010
EMST, OTP, and OTM are input from CN2 connector.
Outputs : DRDY ··· open BRK ··· open
IPOS ··· close HOME ··· open
Press BS to terminate the monitoring.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

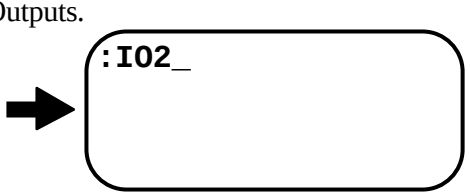
[Example] Verify the Programmable Indexer start command "RUN" is ON.

1) Confirm that the display of Handy Terminal shows the colon ":."

(If the colon does not appear on the display press [ENT] key once.)

2) Input the command to read out state of Inputs/Outputs.

[I] [O] [2 $]

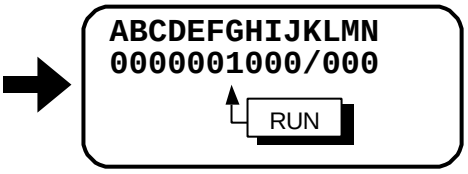


3) Add /RP for repetitious readout.

[/] [R] [P]

4) Press the enter key to execute.
Readout starts immediately after the input.

[ENT]



5) Press the back space key to discontinue read out. If it is not pressed, read out will be repeated and the next command can not be accepted.

[BS]

- Above example shows that readout of RUN input is "1", which indicates "RUN" input is ON.

[Reference]

◊ Readout follows the changes of signal status while repeating reading-out.
(Signals ON and OFF are followed by 1 and 0 in the display.)

◊ If the option code "/RP" is not entered, the read-out at the moment will be displayed for only once.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

9.1.10.3. Reading Current Position

1 Reading current position via the position scale in the unit of pulses

1) Current position is displayed in real time in the units of pulse.
Readout indicated on the display changes immediately following motion of the rotor.

T P 2 $ / R P
ENT

2) Press the BS key to end the display.

BS

2 Reading current position via the position scale in the unit of 1/100 degree

1) Reading current position via the position scale in the unit of 1/100 degree.
Readout indicated on the display changes immediately following motion of the rotor.

T P 5 % / R P
ENT

2) Press the BS key to end the display.

BS

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

9.1.10.4. Analog Monitor

- The voltage between analog output pin (MON) and analog ground pin (GND) on the front panel of the Driver Unit monitors one of the following Motor and Driver Unit conditions.
  - ◊ Velocity ---------- actual velocity of the Motor
  - ◊ Velocity command ---------- velocity command given to the Motor from the Driver Unit
  - ◊ Velocity error ---------- error between velocity command and actual velocity, per one sampling interval
  - ◊ Torque command ---------- torque command given to the Motor from the Driver Unit
  - ◊ Phase C current command -- current command given to the Motor phase C from the Driver Unit
  - ◊ Position command ---------- position command given to the Motor from the Driver Unit
  - ◊ Position error counter -------- error between position command and actual position
- MN command select one of the conditions to be monitored as shown in Table 9-7.

Table 9-7

Monitoring condition	MN command
Velocity	MN 0
Velocity command	MN 1
Velocity error	MN 2
Torque command	MN 3
Phase C current command	MN 4
Position command	MN 5
Position error	MN 6
Position error	MN 7

- The monitor output scale are shown hereunder.

Figure 9-17: Velocity (MN0)

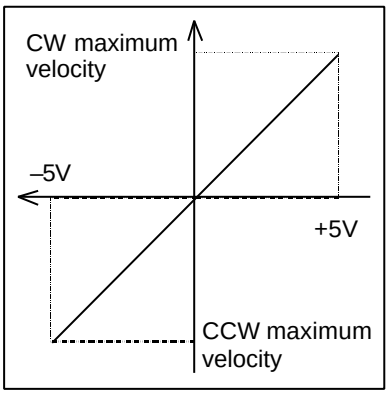
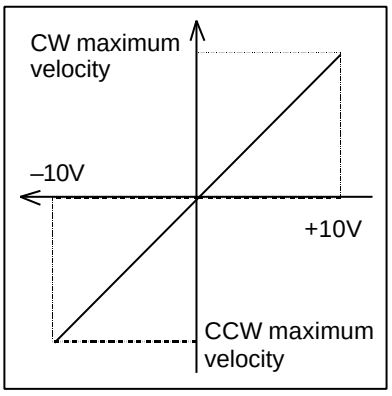


Figure 9-18: Velocity command (MN1)



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Figure 9-19: Velocity error (MN2)

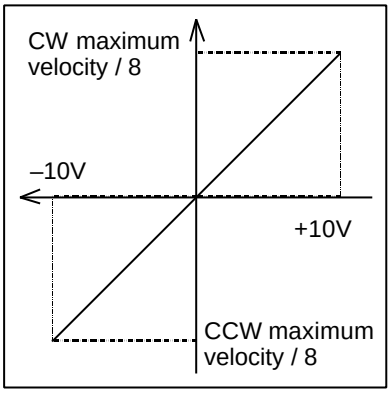


Figure 9-20: Torque command (MN3)

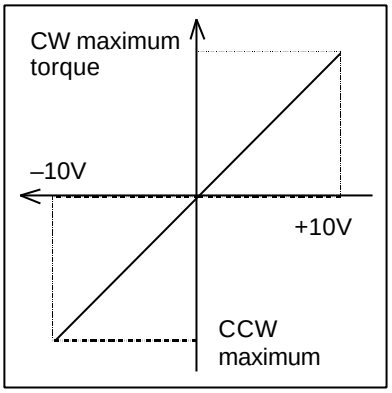


Figure 9-21: Phase C current command (MN4)

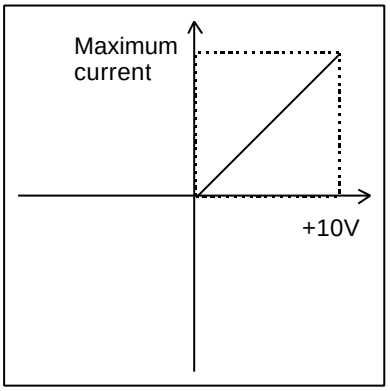


Figure 9-22: Position command (MN5)

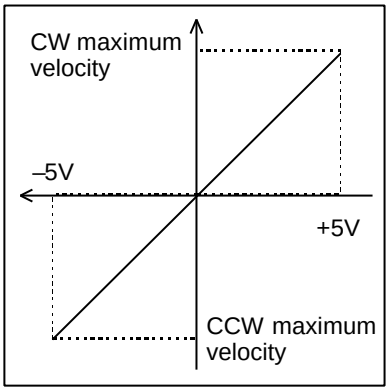


Figure 9-23: Position error (MN6)

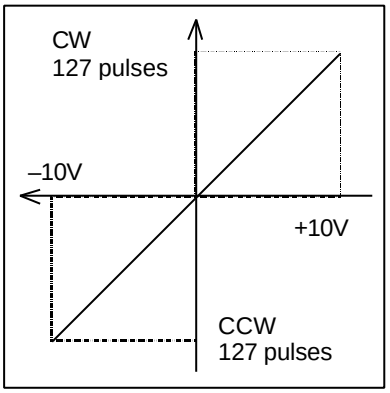
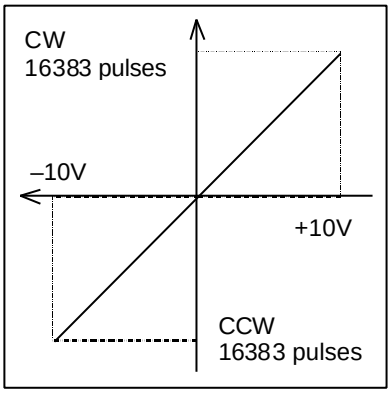


Figure 9-24: Position error (MN7)



Caution : The maximum velocity shown in above figures is for the cases when the selection of resolver resolution is automatic or 10 bit setting.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

9.2. For More Advanced Operation

9.2.1. Position Scale

- The ESA25 Driver Unit has a position scale to control positioning and over-travel limit.

9.2.1.1. Resolution

- The Motor resolver has teeth for detecting its position, and each tooth is digitally divided into 4096. In other words, the resolution of Motor is 4096 × number of teeth.

- Table 9-8 lists Motor series and the resolution.

Table 9-8 *[pulse/r]*

Motor series	Number of teeth	Resolution
YS, JS1, JS2, RS	150	614 400
SS	120	491 520
AS, BS, JS0	100	409 600

9.2.1.2. Direction of Position Scale

Caution : For your safety, the direction of the hardware over-travel limit switches are fixed to the Motor as follow regardless the DI setting:

- ◊ OTP : CW direction
- ◊ OTM : CCW direction

- The direction of position scale counting can be switched by the DI command.

Table 9-9

DI setting	CW direction	CCW direction
DI0*	Plus direction	Minus direction
DI1	Minus direction	Plus direction

* : Shipping set

- When the position scale direction is set, the directions of operations performed by the following functions are also determined.
  - ◊ Pulse train operation
  - ◊ Positioning via communication (IR, ID, AR, AD, HS)
  - ◊ Programmable indexer
  - ◊ Home Return
  - ◊ Jog
  - ◊ Software over-travel limit switch

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

9.2.1.3. Types of Position Scale

- Three types of position scale are available for the user to select the appropriate type for each purpose. Position scale type can be switched by setting the PS command.

Table 9-10

PS setting	Type of position scale	Application
PS0	Linear position scale	Ball screw driving, limit motion range.
PS1*	Single-rotation position scale	General indexer, etc.
PS2-99	Multi-rotation position scale	Chain driving, etc.

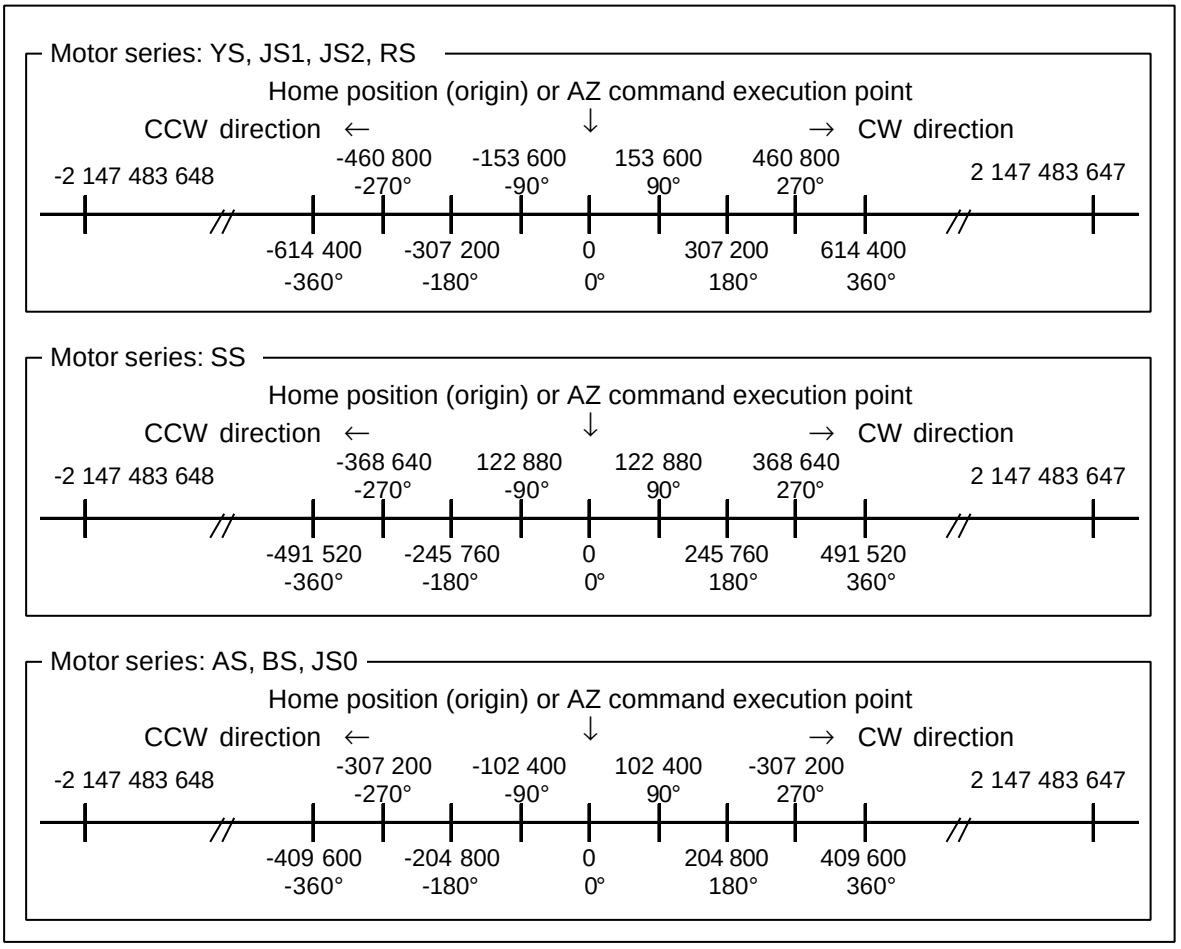
* : Shipping set

1 Linear position scale

- This position scale extends linearly from the origin in both plus and minus directions.

- Scale values range from -2 147 483 648 [pulses] to +2 147 483 647 [pulses] with the Home position at 0. The coordinate value increases in the plus direction. When it exceeds +2 147 483 647 [pulses], the value returns to -2 147 483 648 [pulses]. Falling below -2 147 483 648 [pulses], the value returns to +2 147 483 647 [pulses].

Figure 9-25: Linear position scale



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

2 Single rotation position scale

- Scale starts from the Home position (origin) and extends only in the plus direction. The coordinate value returns to 0 after a 360° turn.

  ◊ Motor Series : YS, JS1, JS2 and RS

  Coordinate values from 0~614 399 [pulses]

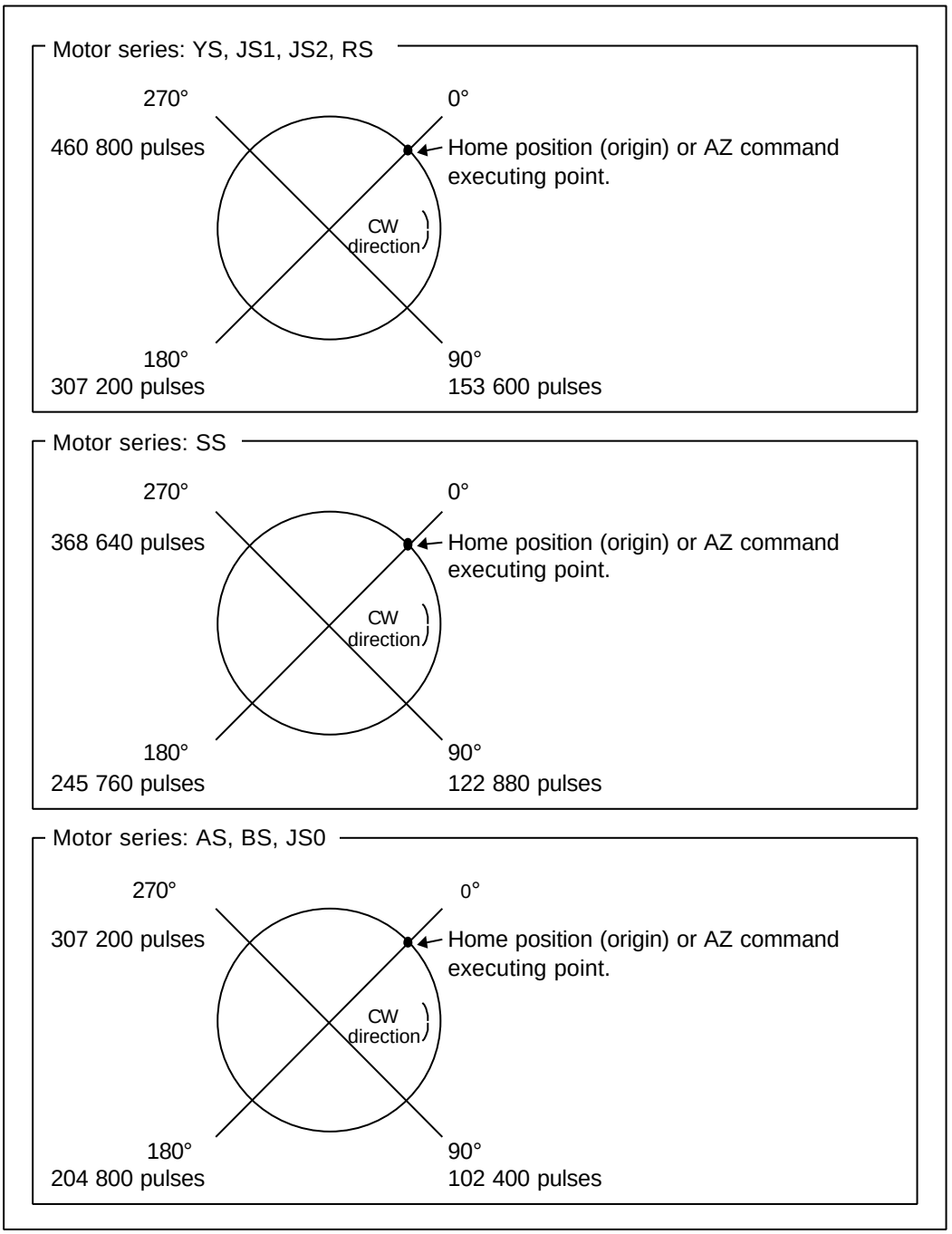
  ◊ Motor Series : SS

  Coordinate values from 0~491 519 [pulses]

  ◊ Motor Series : AS, BS and JS0

  Coordinate values from 0~409 599 [pulses]

Figure 9-26: Single-rotation position scale



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3 Multi-rotation position scale

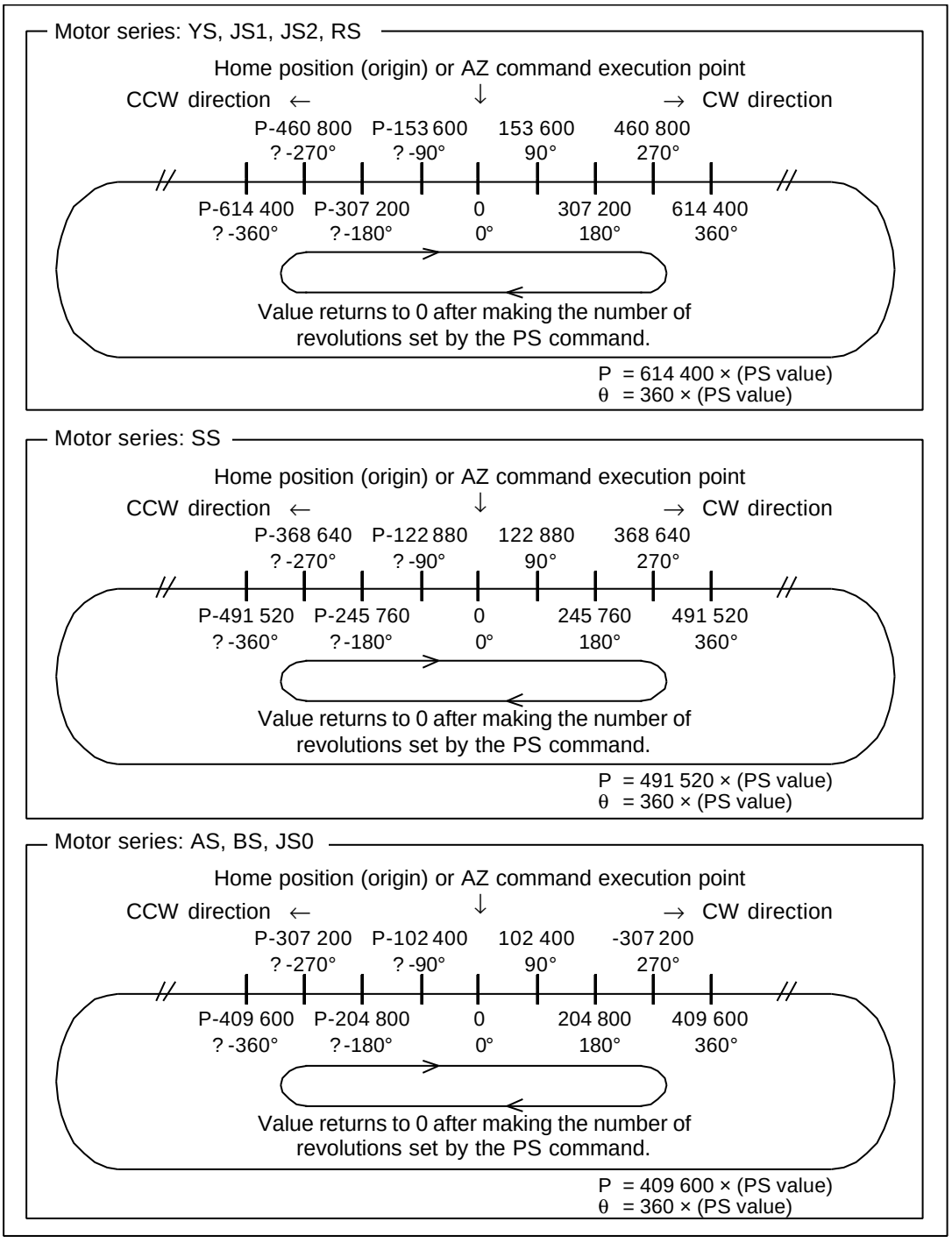
- Scale starts from the Home position (origin) and extends only in the plus direction. The value returns to 0 after making the number of revolutions set by "PS" command.

  ◊ Motor Series : YS, JS1, JS2 and RS
  Coordinate values range from 0 to [614 400 × (PS data) -1]

  ◊ Motor Series : SS
  Coordinate values range from 0 to [491 520 × (PS data) -1]

  ◊ Motor Series : AS, BS and JS0
  Coordinates values range from 0 to [409 600 × (PS data) -1]

Figure 9-27: Multi-rotation position scale


Motor series: YS, JS1, JS2, RS
Home position (origin) or AZ command execution point
CCW direction ←
→ CW direction
P-460 800 ? -270°
P-153 600 ? -90°
153 600 90°
460 800 270°
P-614 400 ? -360°
P-307 200 ? -180°
0 0°
307 200 180°
614 400 360°
Value returns to 0 after making the number of revolutions set by the PS command.
P = 614 400 × (PS value)
θ = 360 × (PS value)
Motor series: SS
Home position (origin) or AZ command execution point
CCW direction ←
→ CW direction
P-368 640 ? -270°
P-122 880 ? -90°
122 880 90°
368 640 270°
P-491 520 ? -360°
P-245 760 ? -180°
0 0°
245 760 180°
491 520 360°
Value returns to 0 after making the number of revolutions set by the PS command.
P = 491 520 × (PS value)
θ = 360 × (PS value)
Motor series: AS, BS, JS0
Home position (origin) or AZ command execution point
CCW direction ←
→ CW direction
P-307 200 ? -270°
P-102 400 ? -90°
102 400 90°
-307 200 270°
P-409 600 ? -360°
P-204 800 ? -180°
0 0°
204 800 180°
409 600 360°
Value returns to 0 after making the number of revolutions set by the PS command.
P = 409 600 × (PS value)
θ = 360 × (PS value)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

9.2.1.4. Position Scale Reset

Caution : • *The position scale value is not decided immediately after the power is turned on. Be sure to reset the position scale before positioning.*

• *The position scale value is reset to 0 by the following operations.*

◊ *Home Return completion*

◊ *AZ command input*

9.2.1.5. Example of Position Scale Setting

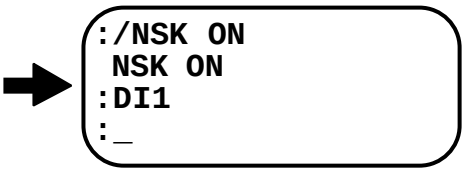
1 Set the CCW direction of the position scale as the plus direction.

1) Input the password.
The password acknowledgment message appears on the display.

/ N S K SP
O N ENT

2) Input the DI command to determine the position scale direction.

D I 1 # ENT



2 Setting the linear position scale

1) Input the password.
The password acknowledgment message appears on the display.

/ N S K SP
O N ENT

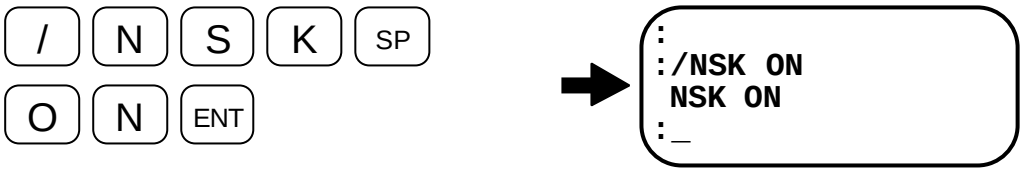
2) Input the PS command to determine the type of position scale.

P S 0 ? ENT

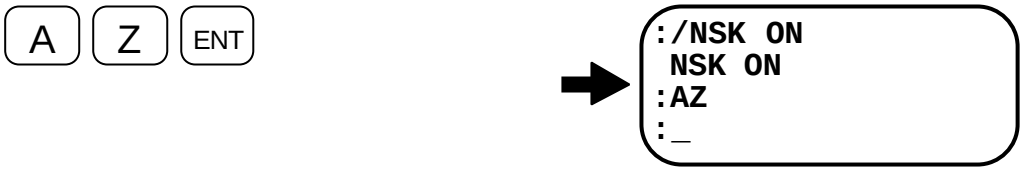
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3 Resetting the position scale value

1) Input the password.
The password acknowledgment message appears on the display.



2) Input the AZ command to reset the position scale value.



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

9.2.2. Direction of Position Scale

Caution : *• When DI data is changed, turn off the power, then the user origin must be reset.*

• Directions of hardware over-travel limit and the phase of position feedback signal output will not be reversed even though the direction of the position scale is reversed.

- Counting direction of position scale may be reversed not to hinder the operation when the Motor mounting position is reversed.
  - ◊ CW/CCW direction are determined from the view of the Motor output axis side.
  - ◊ Direction of counting position scale shall be set by DI data (DI command).
  - ◊ Table 9-11 below shows relations between DI data and direction of counting.

Table 9-11

DI data	Format	CW direction	CCW direction	Shipping set
0	Standard	Plus direction	Minus direction	✓
1	Reversed	Minus direction	Plus direction	

- Direction of the following function/operation will be reversed when the direction of the position scale is reverse.
  - ◊ Direction of all operations
  - ◊ Setting of software over travel limit
  - ◊ Readout of absolute position
  - ◊ Direction of positon off-set

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

9.2.3. Digital Filter

Caution : • *Inserting multiple filters may cause phase inversion of velocity loop in some systems, resulting in unstable operation.*

• *Do not insert more than two filters. Setting a filter frequency too low may cause hunting, etc.; set the frequency to 100 Hz or above.*

Parameters for digital filter setting

◆ Parameters : FP, FS, NP, NS

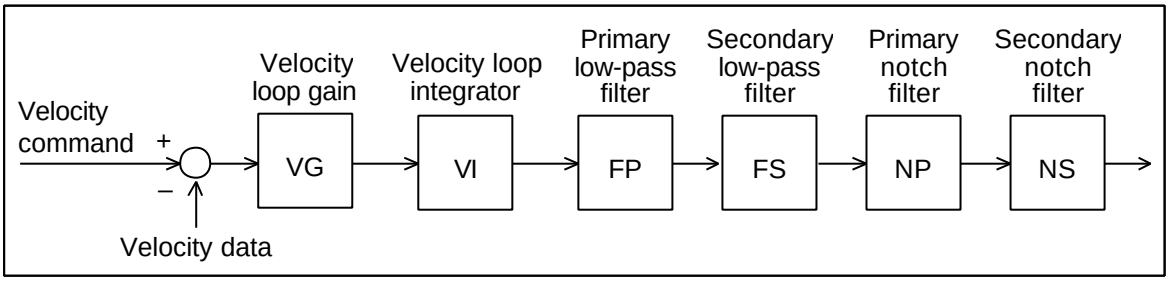
- Sets filter frequency in the velocity loop.
- The filters are useful for eliminating audible noise and vibration due to mechanical resonances.

Table 9-12: Parameter function

Parameter	Function	Shipping set
FP	Sets the primary low-pass filter frequency.	FP0
FS	Sets the secondary low-pass filter frequency.	FS0
NP	Sets the primary notch filter frequency.	NP0
NS	Sets the secondary notch filter frequency.	NS0

- Refer to “12. Command and Parameter” for more details.

Figure 9-28: Digital filter block diagram

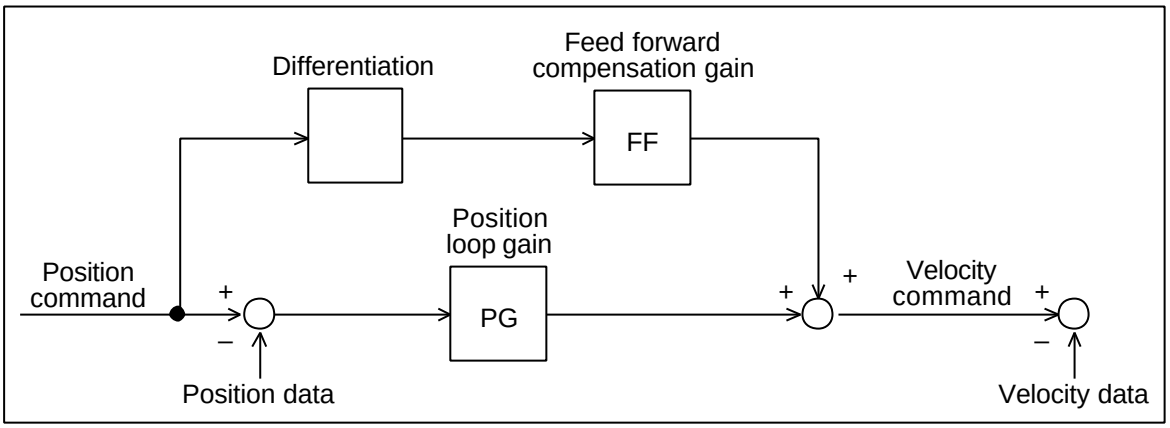


Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

9.2.4. Feed Forward Compensation: FF

- Function of feed forward is to generate a velocity command by differentiating the position command and then add it to the velocity loop in the forward direction. Parameter FF sets the feed forward compensation gain. It requires the password for entry.
- The shipping set of the parameter FF is FF0.
- It improves following error during acceleration / deceleration.
- Setting the FF parameter to a higher value improves the following error. However, overshoot becomes more likely to occur. It is recommended that the parameter is set to 0.5 or below.

Figure 9-29: Feed Forward Compensation Block Diagram



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

9.2.5. Integrator Limit : ILV

- Parameter “ILV” sets the upper limit of the velocity gain. Shipping set is ILV100.
- The password is necessary for setting “ILV”.
- Integrator limiter reduces overshoot caused by the integrator during high acceleration / deceleration.
- The integrator is indispensable for highly precise positioning. However, when a high-speed acceleration/deceleration is specified, errors are likely to accumulate so that integration often results in an overshoot. To prevent this, an integrator limiter is provided to restrict an excessive integration.

* For more details about the parameter, refer to “12. Commands and Parameters”.

Figure 9-30: Integrator limiter block diagram

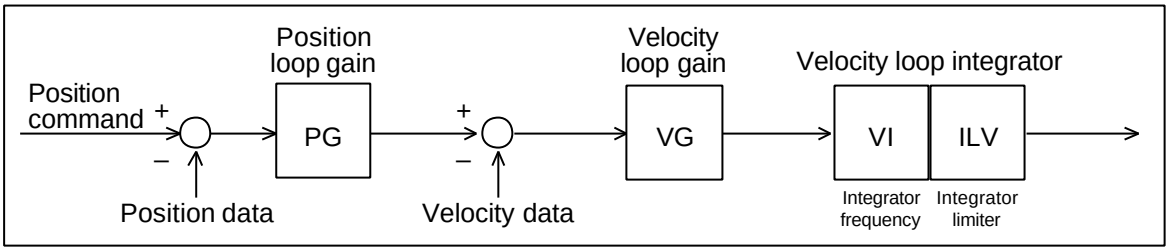
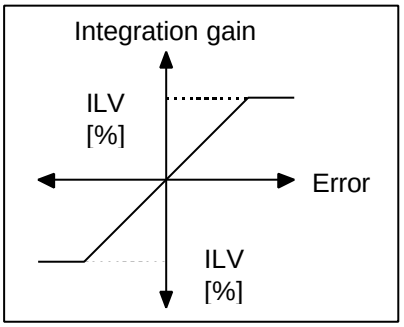


Figure 9-31

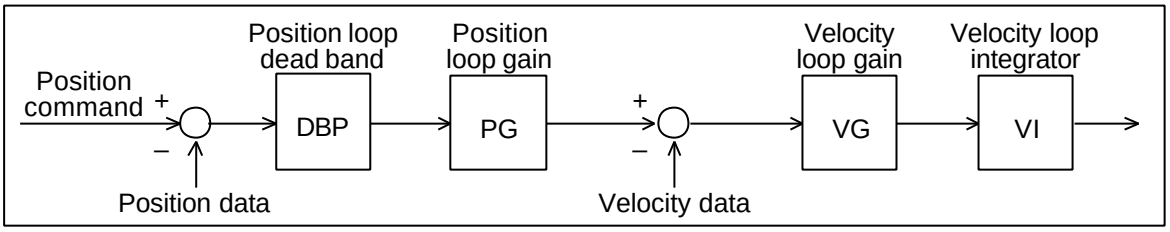


Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

9.2.6. Dead Band Setting : DBP

- Dead band is set in position deviation of position loop. The system disregards the position deviation when it is under the set value of DBP.
- It requires the password for setting. The shipping set is DBP0.
- In some application micro-vibration at the end of positioning is observed due to small position deviation. The dead band is to reduce the micro-vibrations.
- The dead band improves in occurrence of the micro-vibrations, however it worsens positioning repeatability for the value of DBP setting.
- The dead band is centered at “0” to position error and the position deviation under the value of dead band is disregarded. Thus it makes position command to “0.”
- Unit of DBP is the pulse. (equivalent to the resolver resolution in 12-bit specification) If the rsolver resolution is 10-bit specification, set the DBP value in multiples of 4. Refer to “4.2.3. Functional Specifications” for resolution of the resolver.

Figure 9-32: Dead Band Setting Block Diagram



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

9.3. RS-232C Communication

9.3.1. Specification of Communication

- Setting of various parameters, trial running, and adjustment are enabled by issuing commands to the Driver Units through serial communication (i.e., communication through the RS-232C interface).
- The Driver Unit has CN1 as the input/output ports for RS-232C communication.
- When the Handy Terminal (FHT11) is not in use, set the MM parameter to 0.
  MM1 : Standard setting (for the Handy Terminal)
  MM0 : For connection with a personal computer

Table 9-13: RS-232C communication specification

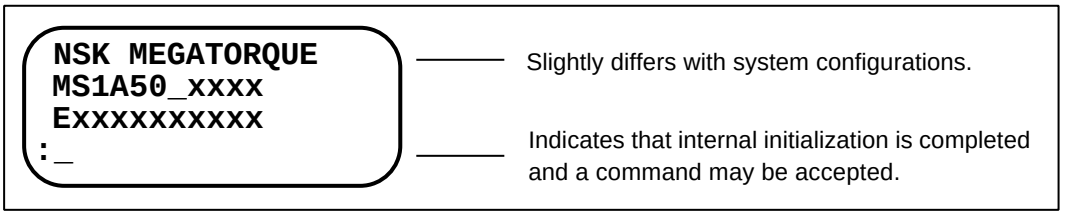
Item	Specification
Transmission	Asynchronous, full duplex
Communication speed	9600 b.p.s.
Word length	8 bit
Stop bit	2 bit
Parity	No
Character code	ASCII code
Communication procedure	• X–On/Off Protocol : No • RTS/CTS Control : Yes

9.3.2. Communication Procedure

9.3.2.1. When Power is Turned on

- If a terminal (such as NSK Handy Terminal FHT11) is connected to CN1 and the Driver Unit power is turned on, the message shown below is displayed.
- The contents (and the number of characters) of this message may differ with the Driver Unit setting and system versions.
- When the Driver Units are initialized, a colon (:) is displayed and the system waits for a command to be entered. (The colon (:) is called a prompt.)

Figure 9-33: Power-on message



Caution : Connect and disconnect the communication cable (CN1) when the power to Driver Unit is off. Otherwise it may lead to an alarm of communication error and system breakdown.

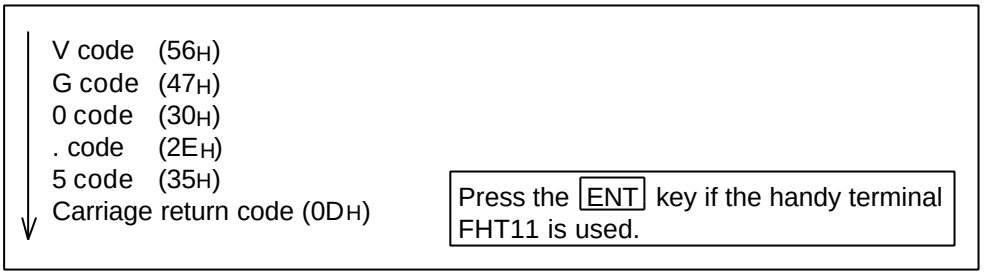
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

9.3.2.2. Command Entry

- A communication command shall consist of “a command (character string) + data (if necessary) + carriage return code (0DH)”.

- If the velocity gain is to be set to 0.5, for example, “VG0.5” should be entered by adding data of 0.5 to a VG command. The characters of this command with data are transmitted to the Driver Unit as shown below:

Figure 9-34: Example Of VG0.5


V code (56H)
G code (47H)
0 code (30H)
. code (2EH)
5 code (35H)
Carriage return code (0DH)
Press the ENT key if the handy terminal FHT11 is used.

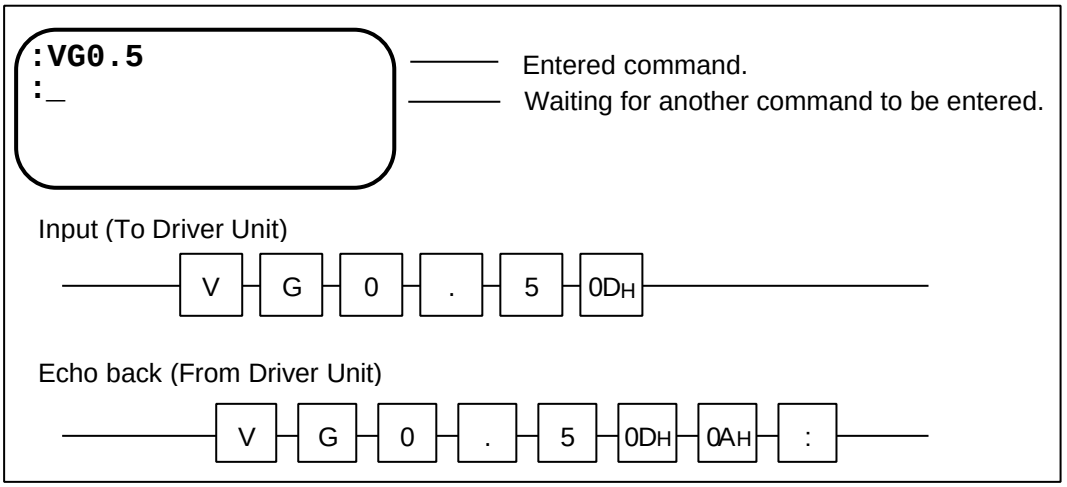
- Every time a character is input, the Driver Unit echoes the character back to the terminal. (The Driver Unit returns the same character that it receives.)

- However, the Driver Unit converts carriage return code to “carriage return code (0DH) + line feed code (0AH),” then returns it to the terminal.

- When a carriage return code is input, the Driver Unit decodes a character string which it has received (VG0.5 in the example above) and executes it. Therefore, a command is not executed unless it ends with a carriage return code.

- If the Driver Unit can decode an entered command, it returns “ : ” close behind the line feed code. If it receives an internal data readout command, etc., it returns the data before “ : ”.

Figure 9-35: Successful input example



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

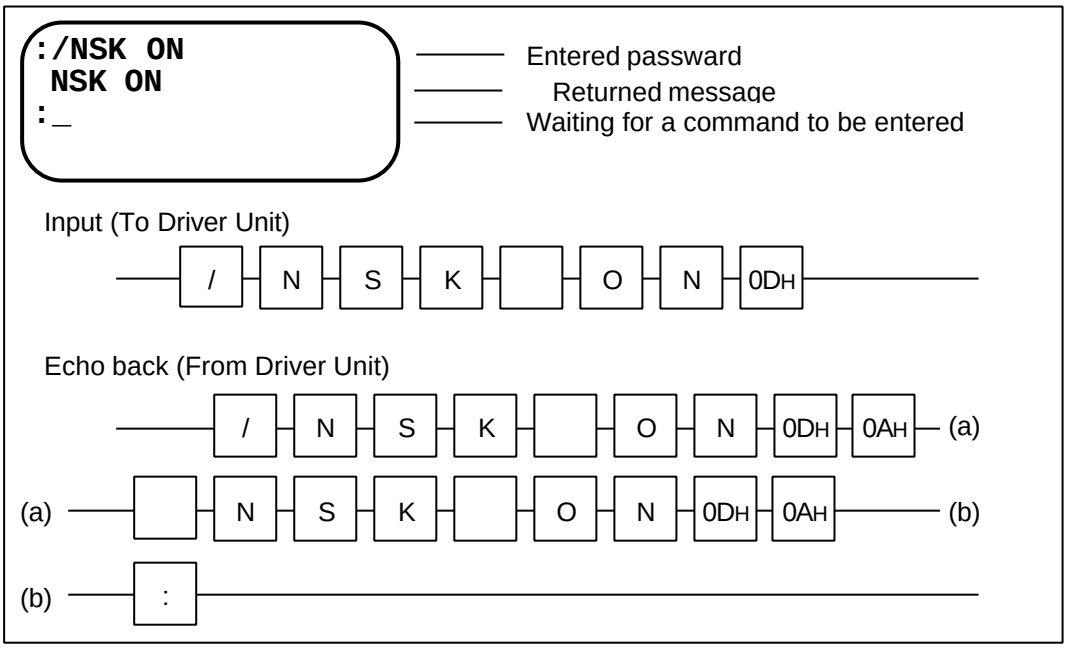
9.3.2.3. Password

- Among the communication commands used for this System, some special commands (such as AB, PA, SI, etc.) require password entry for preventing erroneous entries. These commands cannot be entered in the same manner as other commands.

- The password is /NSK ON (a space between K and O) as shown below. If the Driver Unit accepts it, it returns an “NSK ON” message.

- A command requiring password entry may only be executed immediately after the password is entered.

Figure 9-36: Password Example


:/NSK ON
NSK ON
:_
Entered password
Returned message
Waiting for a command to be entered
Input (To Driver Unit)
/ N S K O N 0DH
Echo back (From Driver Unit)
/ N S K O N 0DH 0AH (a)
(a) N S K O N 0DH 0AH (b)
(b) :

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

9.3.2.4. Canceling Command

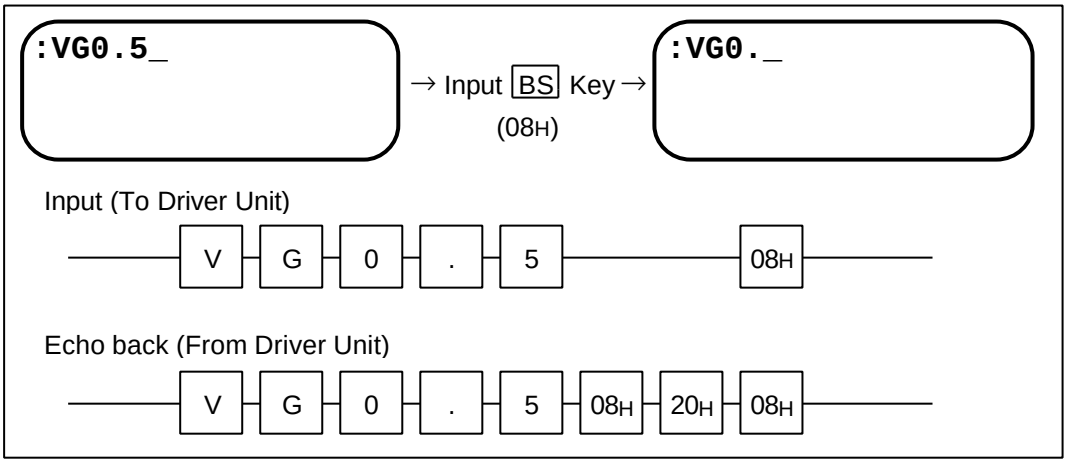
- A command which has been entered halfway, entering a backspace code (08H) can cancel a character or an entered full character string. Parameter “backspace mode” (BM) sets the cancelling method.
  BM0 : a backspace code cancels an entered character string.
  BM1 : a backspace code cancels a character.

[When the Handy Terminal FHT11 is used, press the backspace (BS) key.]

1 Parameter “BM1” (Shipping set)

- For example, when the backspace code is input following VG0.5, the cursor moves one space back to the position where 5 was input and thereby deletes 5.

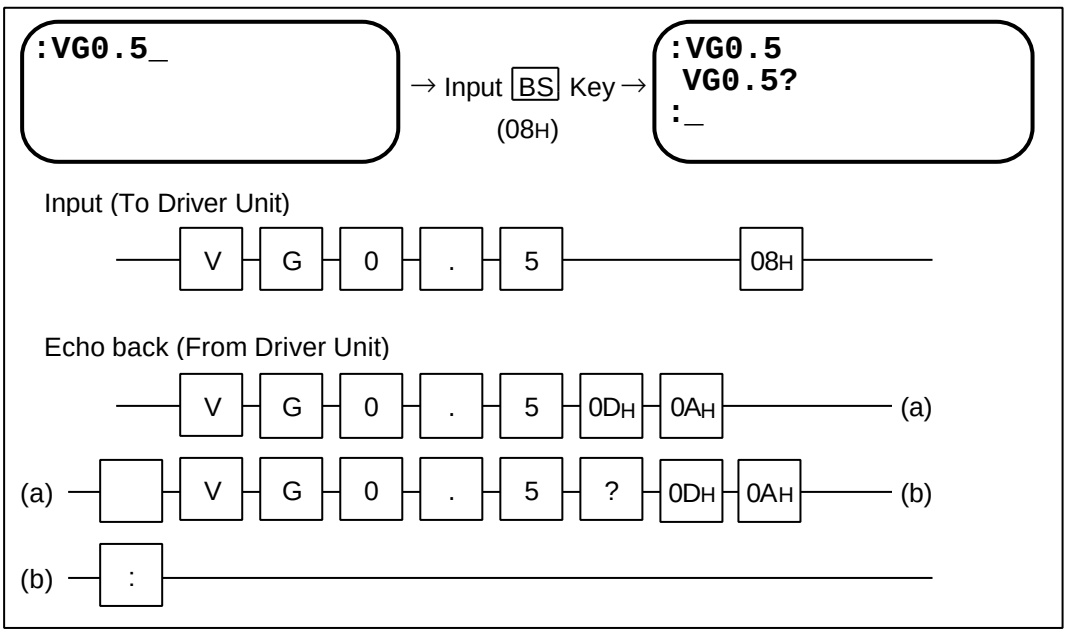
Figure 9-37: Canceling example (BM1)



2 Parameter “BM0”

- For example, when the backspace code is input following VG0.5, a message “VG0.5?” and a colon “ : ” are displayed and thereby deletes “VG0.5.”

Figure 9-38: Cancelling example (BM0)



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

9.3.2.5. Error

- Note that an error occurs in any of the following cases:

  1) If a nonexistent command (i.e., character string) is entered. (If an entered character string cannot be decoded.)

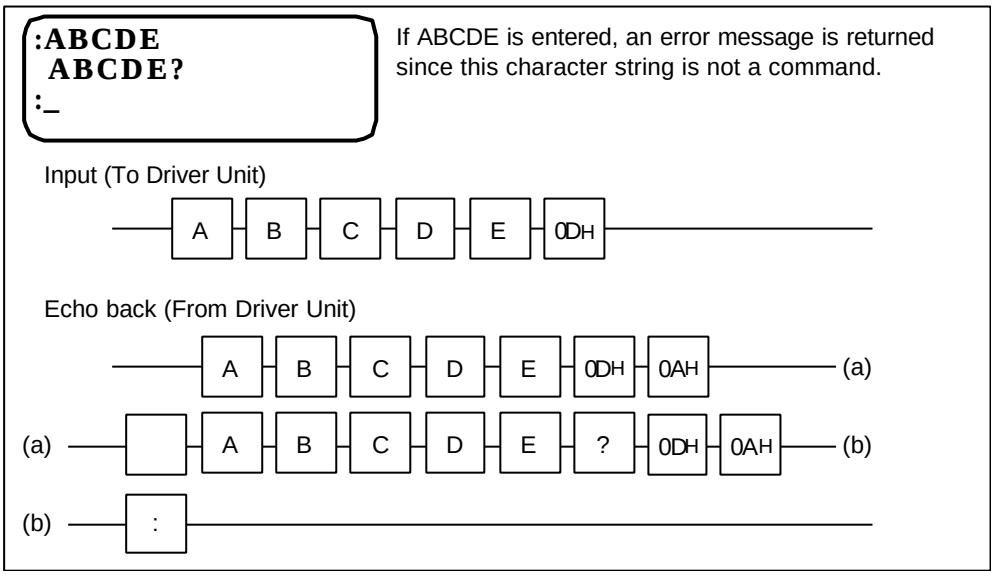
  2) If data or subscript out of the allowable range is entered.

  3) If a command requiring the password is entered without the password.

     ◊ In any of these cases, the entered character string with a "?" mark is returned as an error message.

     ◊ For example,

Figure 9-39: Input error example 1

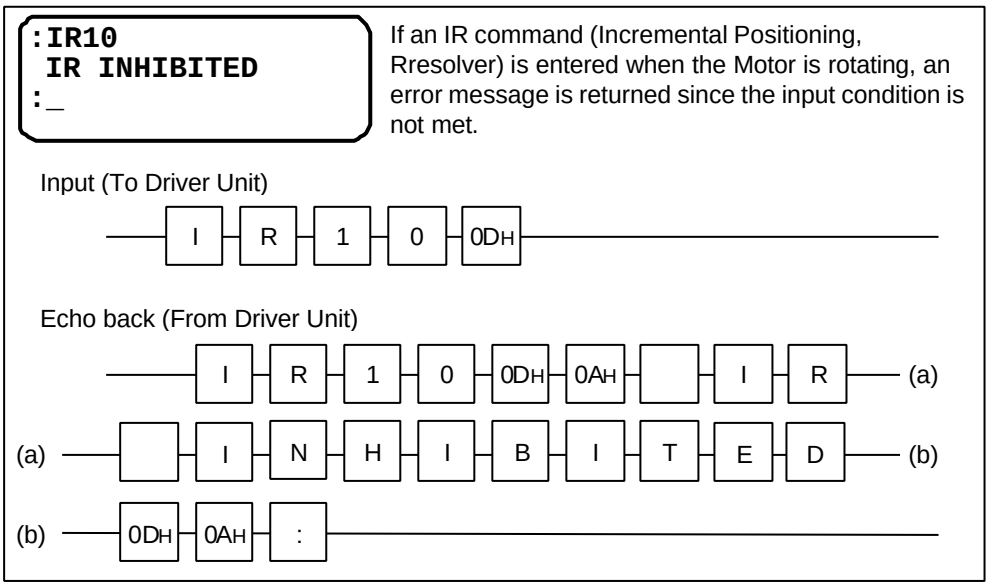

:ABCDE
ABCDE?
:_
If ABCDE is entered, an error message is returned since this character string is not a command.
Input (To Driver Unit)
A B C D E 0DH
Echo back (From Driver Unit)
A B C D E 0DH 0AH (a)
(a) A B C D E ? 0DH 0AH (b)
(b) :

  4) If the input condition is not met when entering a command.

     ◊ In this case, the entered character string with "INHIBITED" is returned.

     ◊ For Example,

Figure 9-40: Input error example 2


:IR10
IR INHIBITED
:_
If an IR command (Incremental Positioning, Rresolver) is entered when the Motor is rotating, an error message is returned since the input condition is not met.
Input (To Driver Unit)
I R 1 0 0DH
Echo back (From Driver Unit)
I R 1 0 0DH 0AH I R (a)
(a) I N H I B I T E D (b)
(b) 0DH 0AH :

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

9.3.2.6. Readout Command

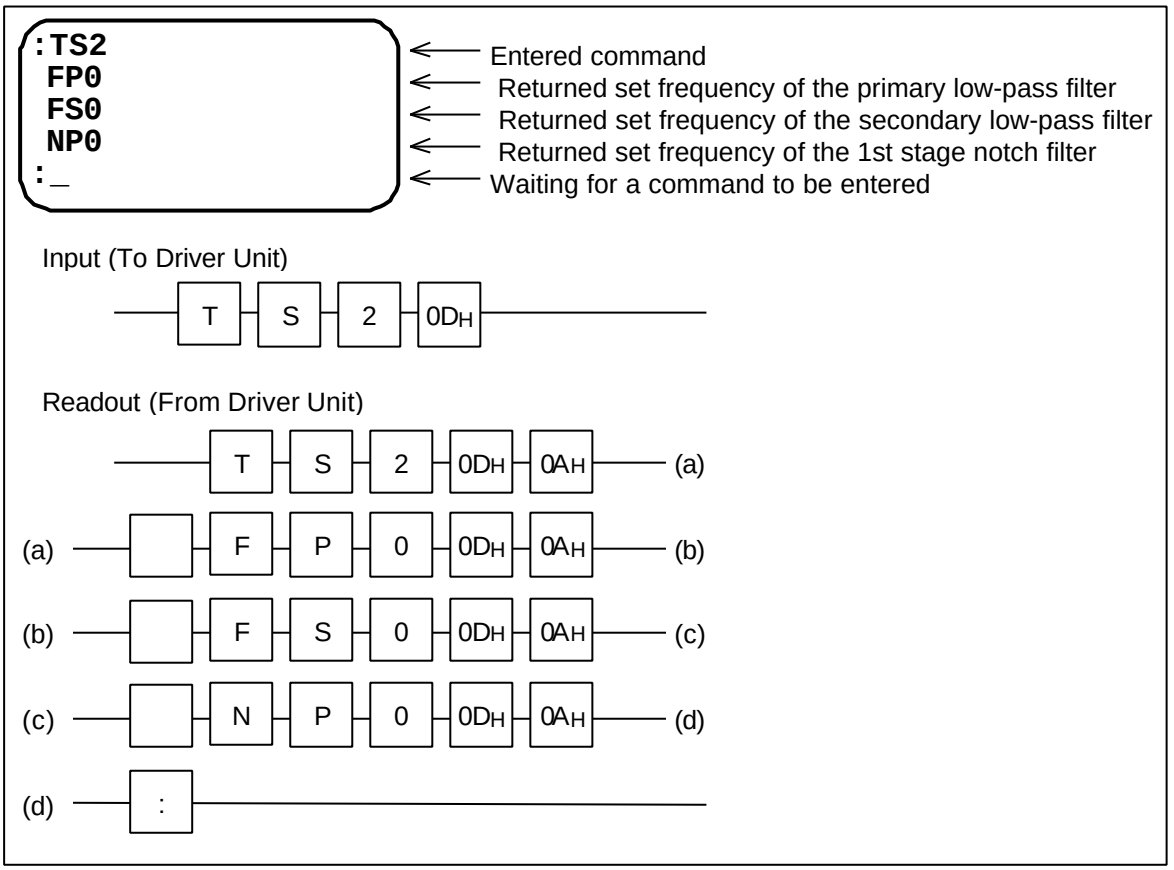
- If a command for reading the internal state (i.e., parameter set values, current position, etc.) of the Driver Unit among the communication commands of this system is entered, the Driver Unit returns data, etc.

- Returned data consists of “space code (20H) + read out value, data + carriage return (0DH) + line feed code (0AH)”.

    ◊ For example,

1 TS command for reading set value

Figure 9-41: TS command example

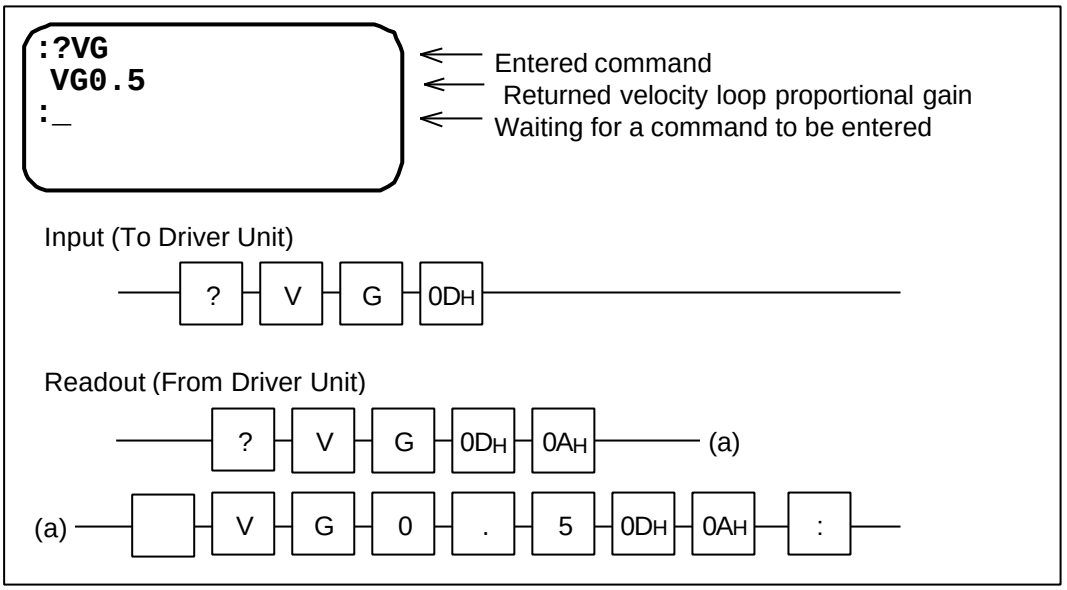

:TS2
FP0
FS0
NP0
:_
Entered command
Returned set frequency of the primary low-pass filter
Returned set frequency of the secondary low-pass filter
Returned set frequency of the 1st stage notch filter
Waiting for a command to be entered
Input (To Driver Unit)
T S 2 0DH
Readout (From Driver Unit)
T S 2 0DH 0AH (a)
(a) F P 0 0DH 0AH (b)
(b) F S 0 0DH 0AH (c)
(c) N P 0 0DH 0AH (d)
(d) :

Caution : Input of [20H] requires for every echo back when the parameter of MM is 1.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

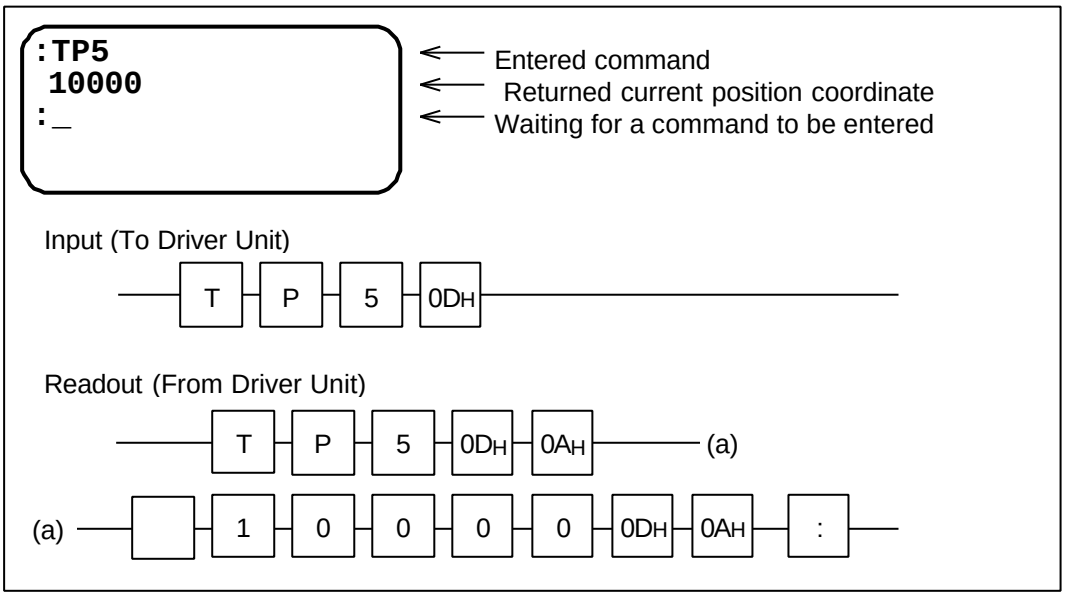
2 If set value reading function ? is used

Figure 9-42: "?" function example


:?VG
VG0.5
:_
Entered command
Returned velocity loop proportional gain
Waiting for a command to be entered
Input (To Driver Unit)
? V G 0DH
Readout (From Driver Unit)
? V G 0DH 0AH (a)
(a) V G 0 . 5 0DH 0AH :

3 TP command for reading current position data

Figure 9-43: TP command example



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

9.3.3. Communication with Personal Computer

- This section describes how to store the parameters of Driver Unit using HyperTerminal of communication software which is provided with Windows 95 as standard.

- The user shall provide the communication cable. Pin-out of the D-sub 9pins connector of ESA Driver Unit is different from DOS/V machine. Refer to "5.1. CN1: RS-232C Serial Communication Connector" and the manual of the personal computer.

9.3.3.1. Set-up of HyperTerminal

1) Start HyperTerminal.
   [(Start menu) → (Program) → (Accessory) → (HyperTerminal)]

2) Dialog of "Setting of connection" is displayed.
   Declare the name of connection and set an icon, then press [OK] button.

3) Dialog of "Telephone-number" is displayed.
   Select "Direct to Com#" in "the way of connection N," then press [OK] button.

4) Dialog box of "Property of Com#" is displayed.
   Follow the table bellow for input, then press [OK] button.

Table 9-14

Bit/sec.	9 600
Data bit (D)	8
Parity (P)	None
Stop bit (S)	2
Flow control (F)	Hardware

5) Select the menu "File (F)" → "Property (P)."
   Dialog of "Property of xxxx" is shown in the display.
   [xxxx is the name of connection declared in the procedure 1).]

6) End of HyperTerminal.
   The dialog box stating "Do you store the session xxxx ?" is displayed.
   Press [Yes (Y)] button and store the session. Use the session to communicate with ESA Driver Unit afterwards.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

9.3.3.2. Store Parameters of ESA Driver Unit

1) Start HyperTerminal.

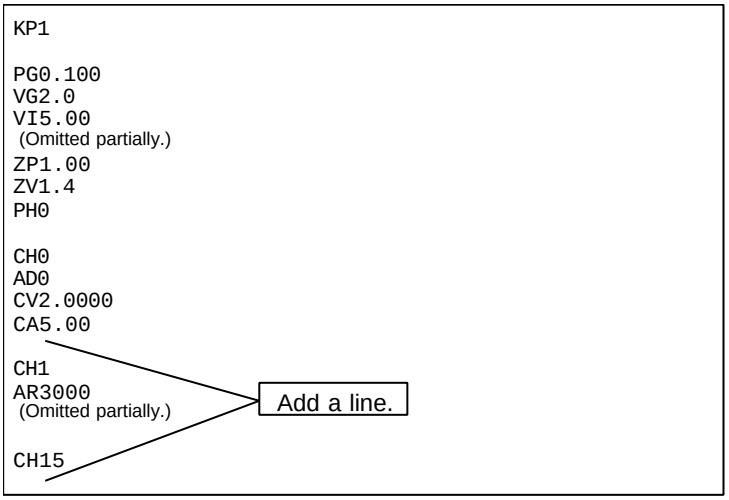
2) Set MM data to MM0 for continuous report mode.

3) Execute TS command and TC/AL to indicate the setting.

```
:MM0
:TS
 PG0.100
 VG2.0
 VI5.00
 (Omitted partially.)
 RI0.020
 ZP1.00
 ZV1.4
:TC/AL
 PH0
>TC0
 AD0
 CV2.0000
 CA5.00
 (Omitted partially.)
>TC15
:
```

4) Copy the setting shown above to “Memopad,” then store it as a text file.
Edit and store the setting as described hereunder to be able to transfer it to ESA Driver Unit.

- ◆ Add “KP1” to the top line.
- ◆ Delete unnecessary character strings such as “:TS” and “:TC/AL.”
- ◆ Delete all spaces of the head of the lines.
- ◆ Change “>TC” to “CH.”
- ◆ Add a line to each end of a channel program and the end of setting.



9.3.3.3. Transmit Stored Parameters to ESA Driver Unit

■ Transmit the stored file to ESA Driver Unit.

1) Start HyperTerminal.

2) Transmit the file by selecting “Transfer” → “Transmit text/file.”

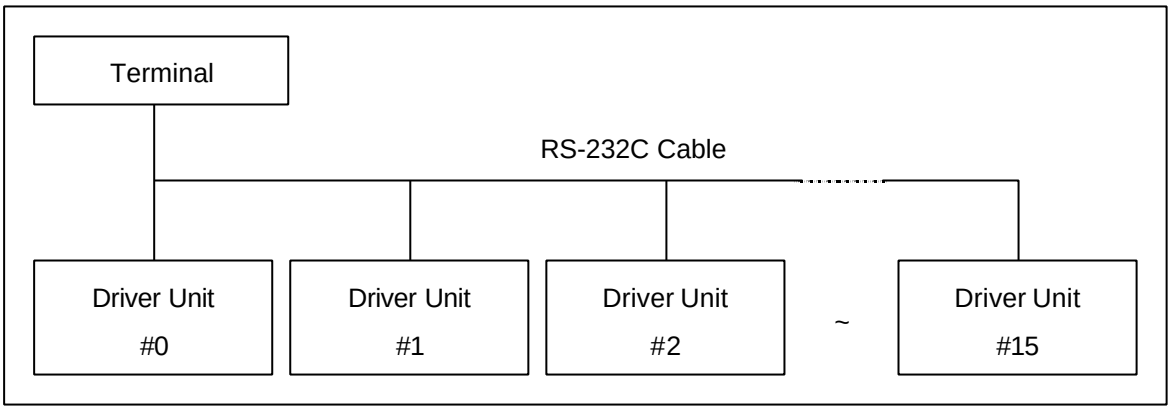
3) Execute TS or TC/AL command to confirm that the transmission of data is successful.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

9.3.4. Daisy Chain Communication

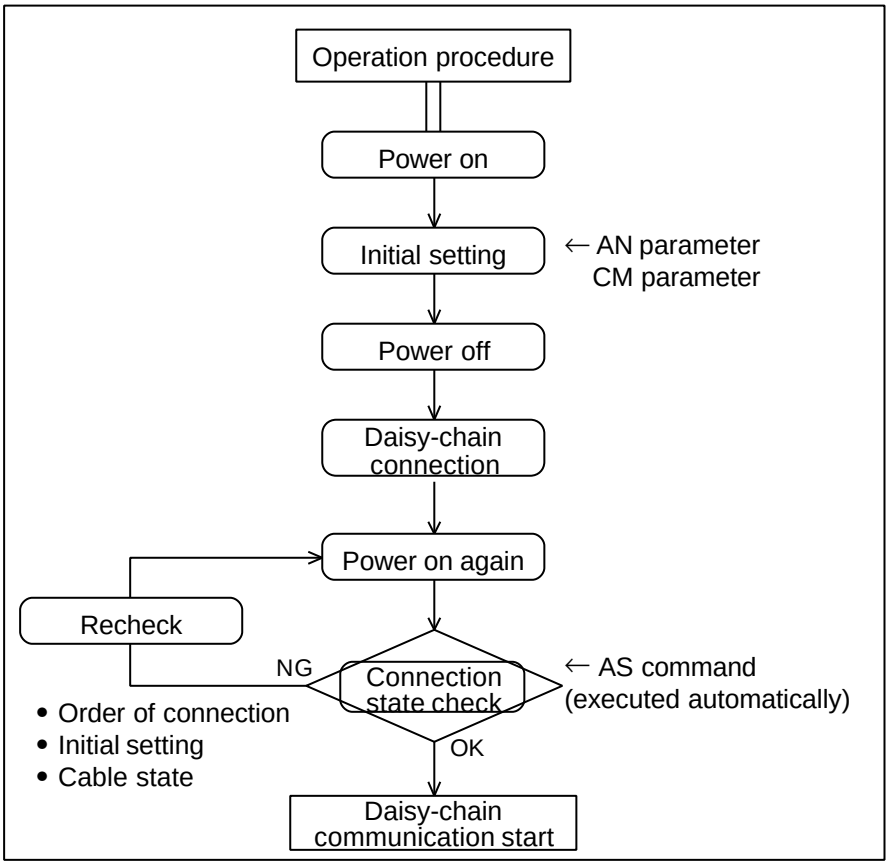
- Daisy chain communication allows multiple Driver Units (up to 16 units) to be connected with a single RS-232C terminal.

Figure 9-44: Daisy chain communication overview



9.3.4.1. Procedure to Set Daisy Chain Communication

Figure 9-45: Setting procedure for daisy chain communication.



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

9.3.4.2. Initial Setting

- The password is necessary for inputting initial setting parameters.
- The initial setting values become valid when the power is turned on next time.
- Perform initial setting before making daisy chain connection.

Table 9-15: Initial setting

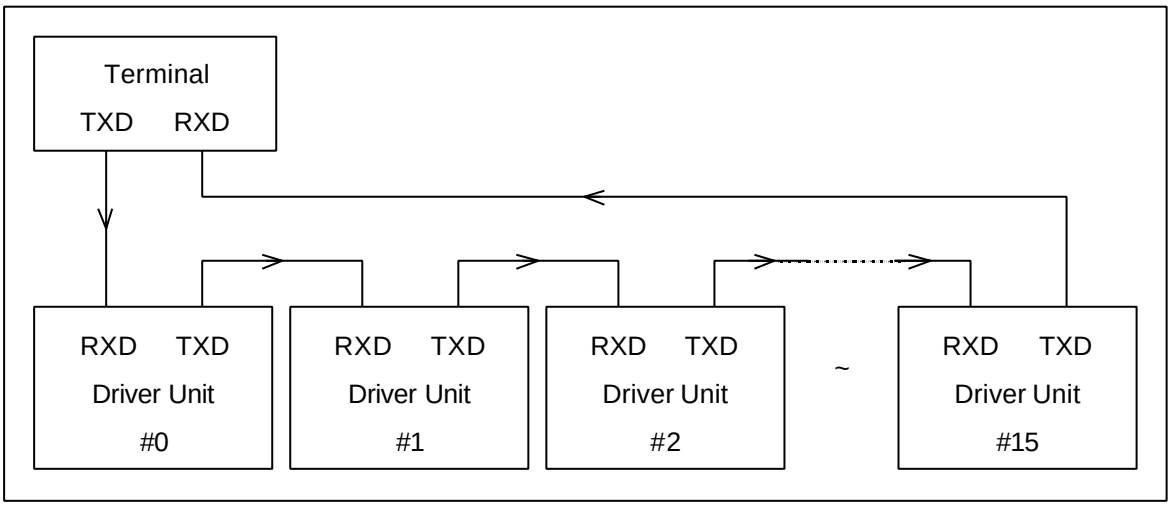
Item	RS2-32C parameter	Data range	Shipping set	Function
Daisy-chain communication, axis number setting	AN data	0~15	0	The set data becomes the axis number of daisy chain communication.
Daisy-chain communication mode selection	CM data	0, 1	0	CM0: standard (single driver) communication CM1: daisy-chain communication

9.3.4.3. Interfacing

1 Connecting data communication lines

- Connect data communication lines sequentially: First connect the output of the terminal with the input of axis 0, then connect the output of axis 0 with the input of axis 1 and then one after the other. (See Figure 9-46.)
- Connect the output of the final axis with the input of the terminal.

Figure 9-46: Data line connection

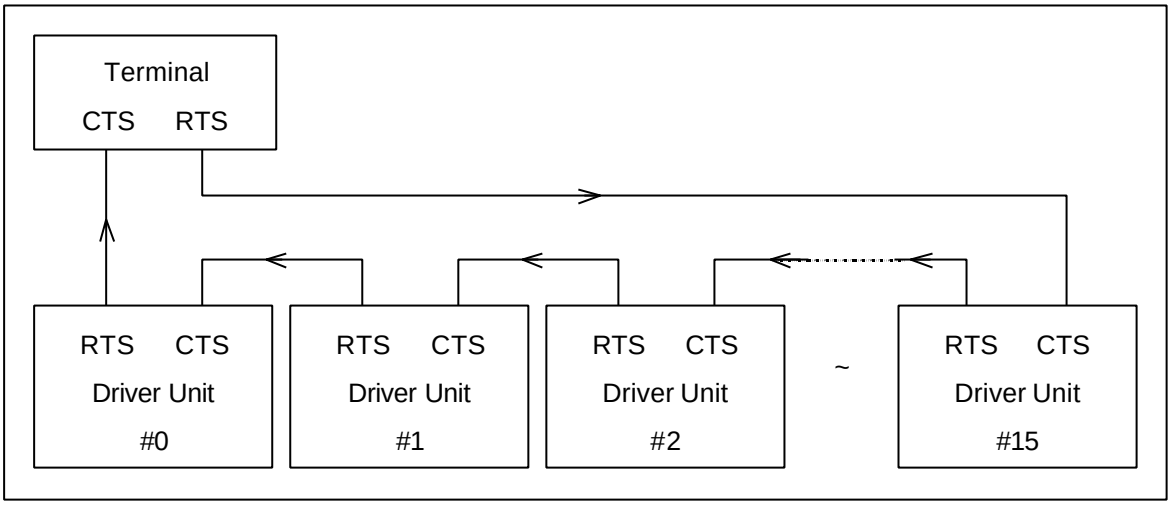


Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

2 Connecting data transmission request lines

- Connect data transmission request lines sequentially: First connect the input of the terminal with the output of axis 0, then connect the input of axis 0 with the output of axis 1 and then one after the other. (See Figure 9-47.)
- Connect the input of the final axis with the output of the terminal.

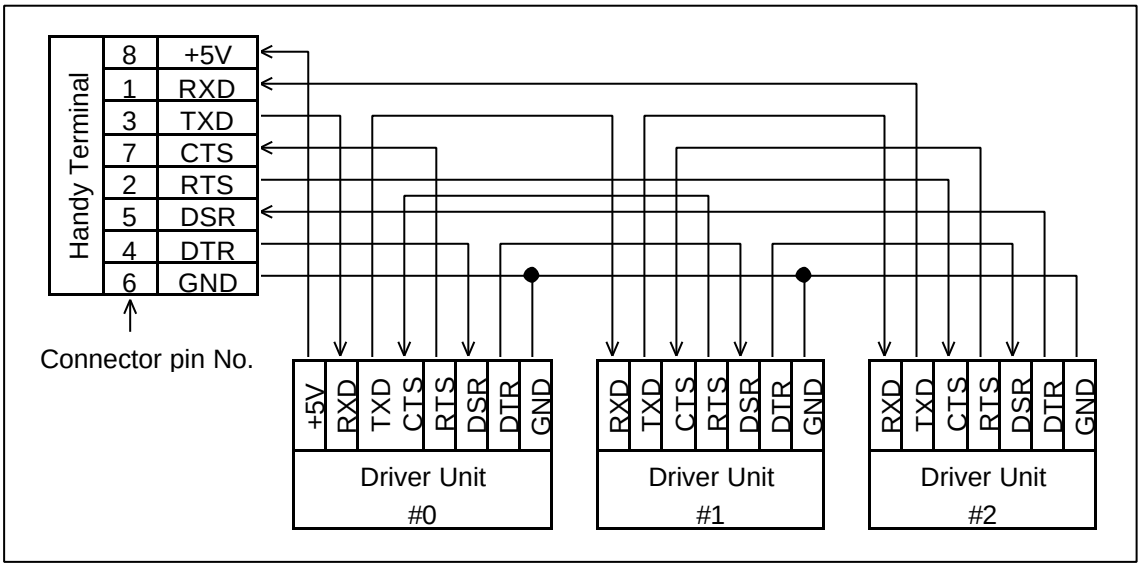
Figure 9-47: Request-to-send Line Connection



Actual connection example

- When NSK's Handy Terminal is in use, connect the lines as shown in Figure 9-48.
- Refer to "5.1. CN1 : RS-232C Serial Communication Connector" for the specification of CN1.

Figure 9-48: Handy Terminal Connection Example



*: The communication signal name on the Handy Terminal is opposite to that on the Driver Unit (e.g. RXD-TXD).

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

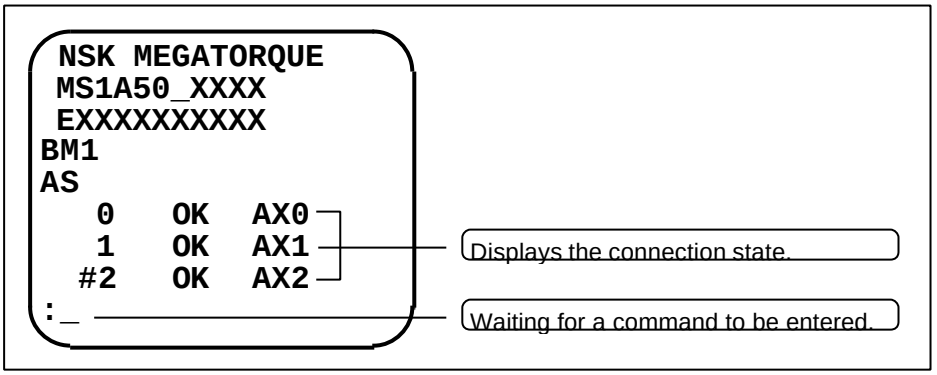
9.3.4.4. Power on

Caution : *• If the Handy Terminal is not used, turn on power in the order of the RS-232C terminal and Driver Units.*

• Turn on the power for all Driver Units simultaneously. (If all axes cannot be turned on at once, be sure to design the system so that the power of the Driver Unit axis No. 0 turns on at the end.)

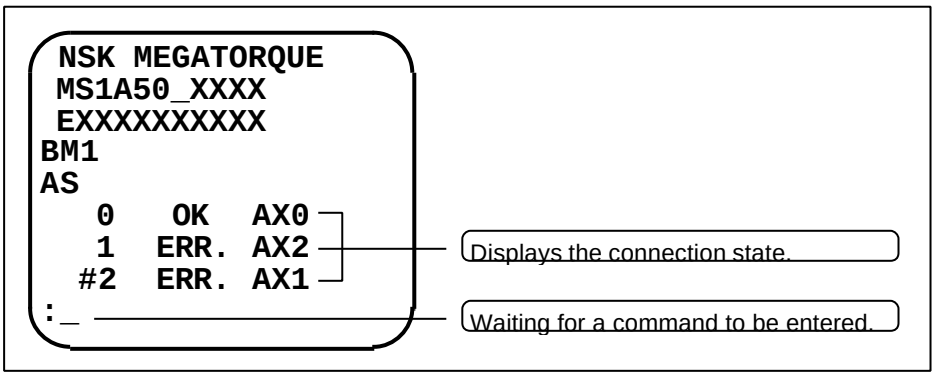
- When the Driver Unit of axis No.0 is turned on, an AS command is executed to check for connection.
- If all the terminal and units are connected properly, the following message is displayed (the following examples show a 3-axis configuration)

Figure 9-49



- If connection is improper, the following message may be displayed.
- The following message example shows a case where axis No.1 and axis No.2 are swiched in connection.

Figure 9-50



- If the proper message is not displayed, check for connection order, initial settings (AN parameter, CM parameter) and cable connection.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

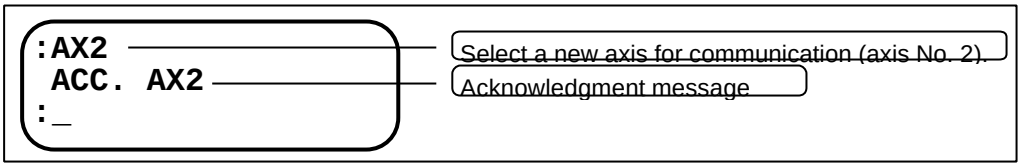
9.3.4.5. Operation

◆ Selection of Driver Unit to be communicated

- In daisy chain mode, the RS-232C terminal is capable of communication through one Driver Unit.
- Use an AX command to select one of the Driver Units connected for daisy chain communication.

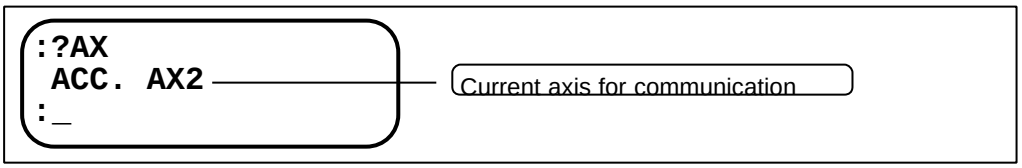
  Caution : *Do not select any unit that is not connected. Otherwise, operation may hang up. To return to the normal state, press the* BS *key, then select the number of a connected Driver Unit.*

Figure 9-51



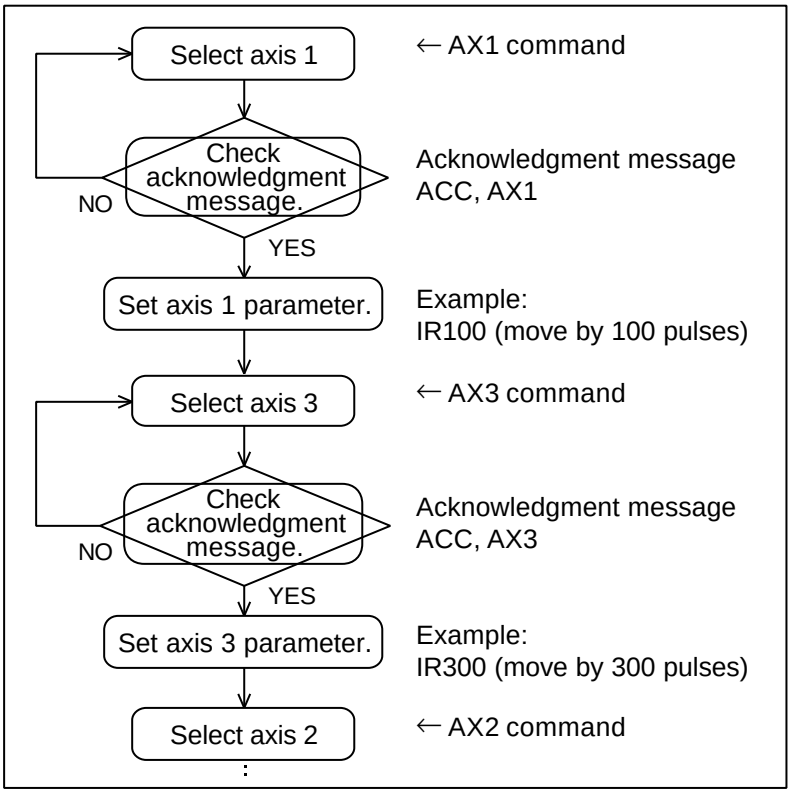
- An axis selected for communication may be checked by issuing a ?AX command. The axis is displayed in the same manner as it is selected.

Figure 9-52



◆ Example of Daisy-chain communication

Figure 9-53: Example of Daisy chain communication



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

(Blank Page)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

10. Operation

10.1. Preparation

10.1.1. Wiring Check

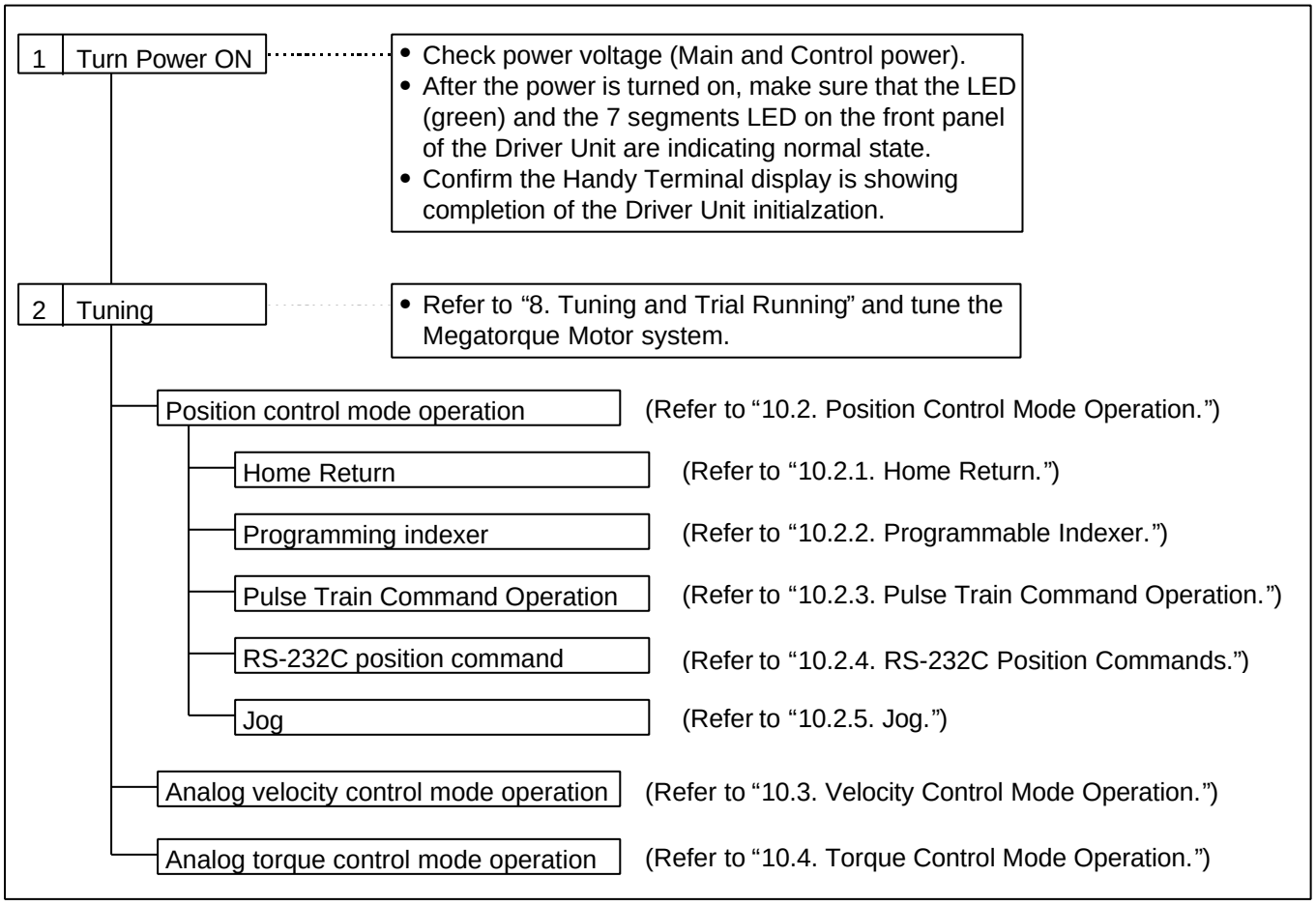
Caution : After completion of all wiring of ESA25 Driver Unit, check followings before operation.

Table 10-1

	Check item	Confirmation
1	Connection of Main power and Input/Output cables	• All wiring is properly arranged and completed. • Terminal block screws are securely fastened. • All connectors are connected and locked properly.
2	Cable Set	• Cable Set (Motor and Resolver cables) is connected and locked properly.
3	Handy Terminal	• Handy Terminal (FHT11) is connected and locked to CN1 connector.

10.1.2. Procedure for Positioning Operation

Figure 10-1


1 Turn Power ON
• Check power voltage (Main and Control power).
• After the power is turned on, make sure that the LED (green) and the 7 segments LED on the front panel of the Driver Unit are indicating normal state.
• Confirm the Handy Terminal display is showing completion of the Driver Unit initialzation.
2 Tuning
• Refer to “8. Tuning and Trial Running” and tune the Megatorque Motor system.
Position control mode operation
(Refer to “10.2. Position Control Mode Operation.”)
Home Return
(Refer to “10.2.1. Home Return.”)
Programming indexer
(Refer to “10.2.2. Programmable Indexer.”)
Pulse Train Command Operation
(Refer to “10.2.3. Pulse Train Command Operation.”)
RS-232C position command
(Refer to “10.2.4. RS-232C Position Commands.”)
Jog
(Refer to “10.2.5. Jog.”)
Analog velocity control mode operation
(Refer to “10.3. Velocity Control Mode Operation.”)
Analog torque control mode operation
(Refer to “10.4. Torque Control Mode Operation.”)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

10.2. Position Control Mode Operation

- Select a position control mode with the parameter SL.

  SL1 : Analog torque control mode

  SL2 : Analog velocity control mode

  SL3 : Position control mode

- Following operations are available in the position control mode.

  ◊ Home Return operation

  ◊ Programmable indexer

  ◊ Pulse train command operation

  ◊ RS-232C position command

  ◊ Jog

10.2.1. Home Return

- Be sure to perform Home Return at all times except when user's controller is governing control. The Home position (Zero position) cannot be determined unless Home Return is performed.

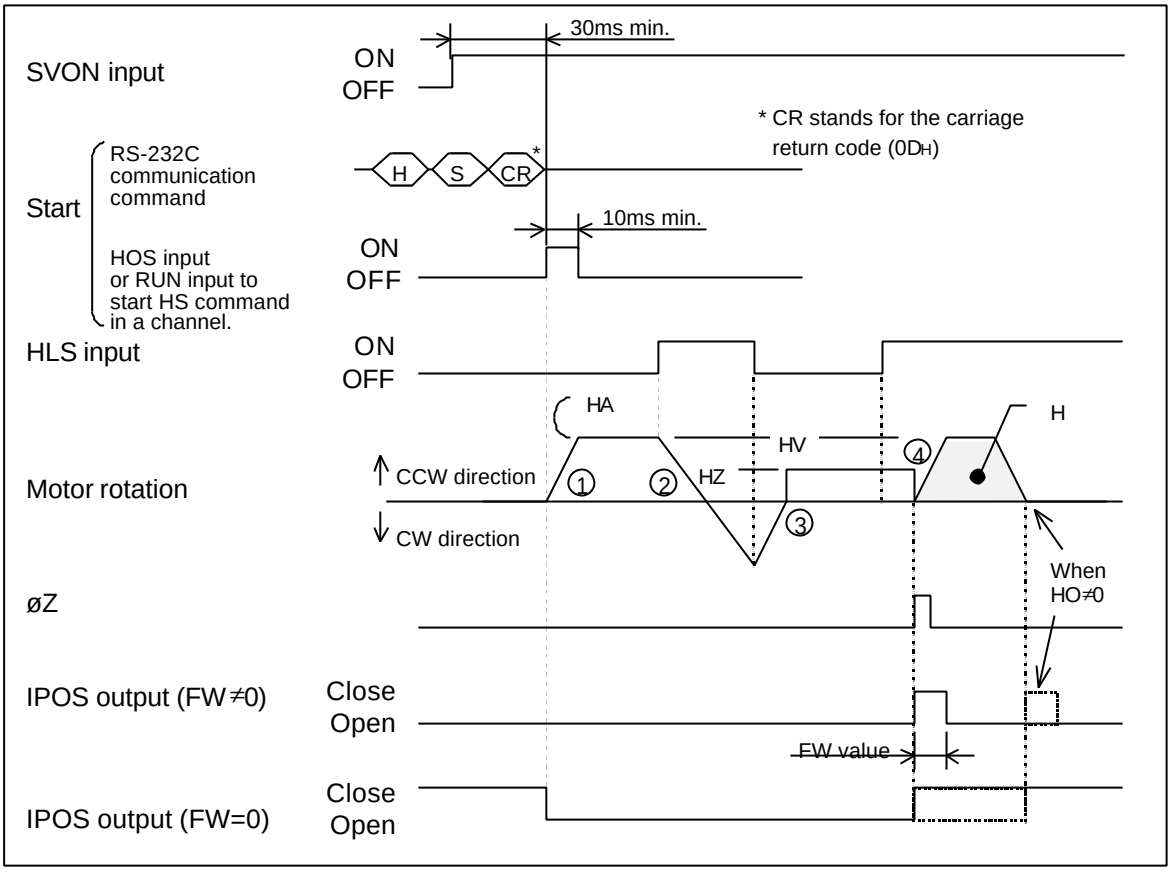
- The position coordinates and positions of software overtravel limit switch are set to the position scale determined by Home Return.

- The Home position (Zero position) of the position scale is set to the point at where Home Return completes.

  Caution *: Position data disappears after the power is turned off, so perform Home Return each time you turn on the Driver Unit power.*

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Figure 10-2 : Home Return sequence



- Make the Motor Servo-on. (SVON input on)
- Turning the HOS input ON will start Home Return. (①)
- The Motor turns in CCW*. When it enters HLS (Home position proximity) area (②), it decelerates and stops momentarily, then reverses its rotational direction. (③) The Motor goes out HLS range once, then reverses again and enters HLS area at the Home position search velocity. (④) It moves to the first point where the resolver value becomes 0 (= rising edge of the øZ) and completes Home Return.

  * The direction of rotation can be changed with the parameter HD (Home Return direction).

    HD0 : CW

    HD1 : CCW (Shipping set)

- If the Home offset value HO is set, the Motor moves farther past the resolver 0 point by the offset value, then completes Home Return operation.
- Home Return can be also executed with the following ways.

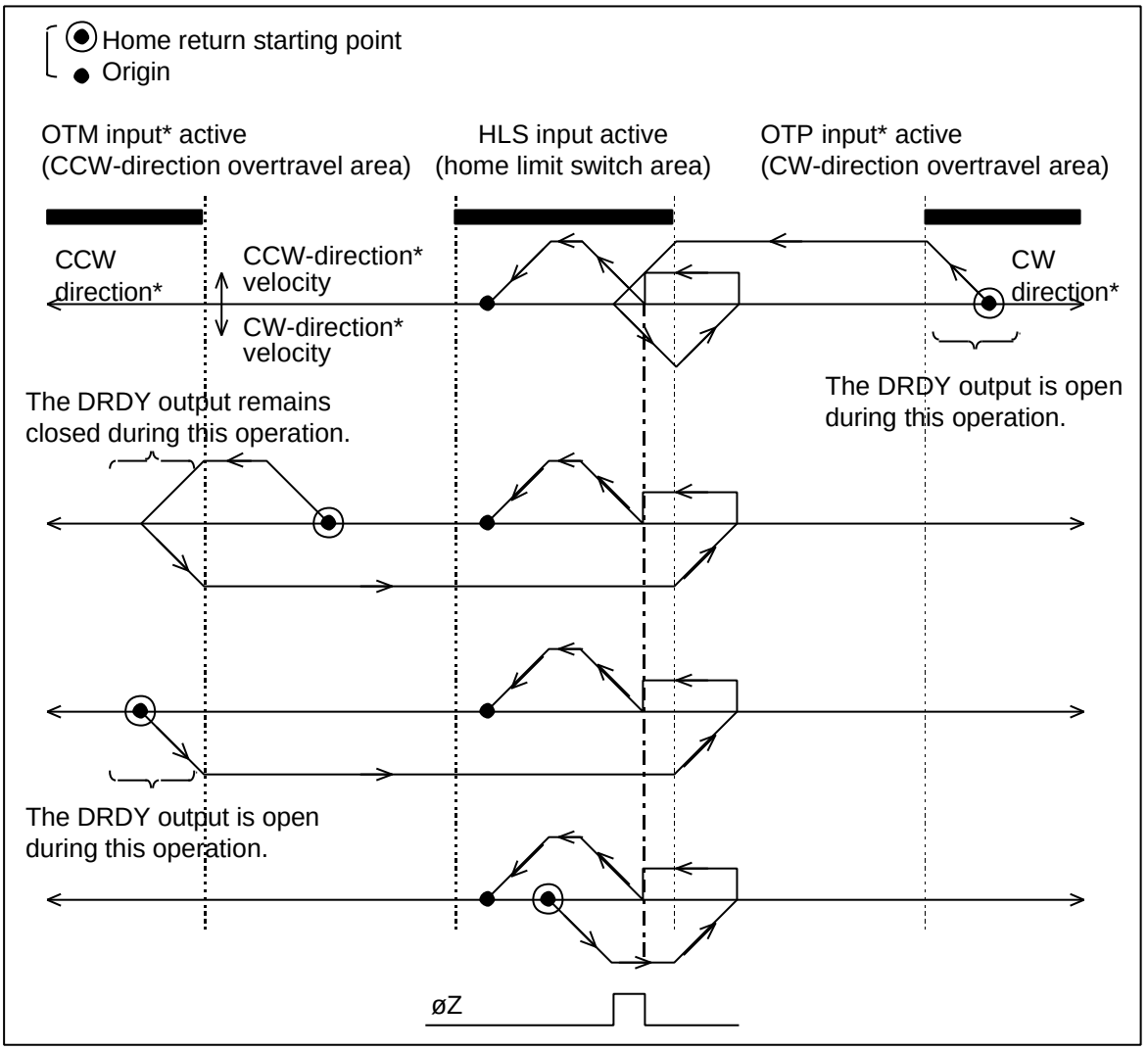
  ◊ Select the channel where HS command is set and input RUN command.

  ◊ Execute HS command through RS-232C communication.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

- Home Return motion differs as shown in Figure 10-3 according to the starting point of Home Return.

Figure 10-3



* : When Home Return direction is reversed by the HD parameter, CW and CCW as well as OTP and OTM are reversed as follows: CW → CCW, OTP → OTM.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

10.2.1.1. Home Return Parameter List

Table 10-2 : Motor series : YS, JS1, JS2 and RS

Parameter function	RS-232C Parameter	Unit	Data input range	Shipping set
Home Return Acceleration	HA	s^{-2}	0.01~80.00	1.00
Home Return Velocity	HV	s^{-1}	0.0001~3.0000	0.2
Home Position Offset	HO	pulse	0~610 304	0
Home Return Direction	HD	–	0: CW, 1: CCW	1
Home Return Near-Zero Velocity	HZ	s^{-1}	0.0001~0.20	0.0100

Table 10-3 : Motor series : SS

Parameter function	RS-232C Parameter	Unit	Data input range	Shipping set
Home Return Acceleration	HA	s^{-2}	0.01~100.00	1.00
Home Return Velocity	HV	s^{-1}	0.0001~3.7500	0.2
Home Position Offset	HO	pulse	0~487 424	0
Home Return Direction	HD	–	0: CW, 1: CCW	1
Home Return Near-Zero Velocity	HZ	s^{-1}	0.0001~0.25	0.0100

Table 10-4 : Motor series : AS, BS and JS0

Parameter function	RS-232C Parameter	Unit	Data input range	Shipping set
Home Return Acceleration	HA	s^{-2}	0.01~120.00	1.00
Home Return Velocity	HV	s^{-1}	0.0001~4.5000	0.2
Home Position Offset	HO	pulse	0~405 504	0
Home Return Direction	HD	–	0: CW, 1: CCW	1
Home Return Near-Zero Velocity	HZ	s^{-1}	0.0001~0.30	0.0100

10.2.1.2. Adjusting Home Position Switch and Home Offset Value

- The position of the Home position sensor (a dog or a sensor) must be adjusted properly to perform Home Return accurately.

- The Home position is determined at the point where the resolver value becomes zero after detection of HLS input rising edge when motor is running under Home Return near-zero velocity. (The home position is set to the point that is off-set by HO, if the Parameter HO value is not set to 0 (zero).)

- The resolver has many teeth for detecting its position and the rising edge of HLS is to identify a tooth out of these teeth. To make precise detection of øZ, the Home limit switch position must be adjusted so that the HLS input goes high when the switch is at the middle center of the tooth width. Design the Home limit switch so that it can be adjusted ±1.2° or more in relation to the tooth width.

- Take the following steps to adjust the position of the Home limit switch.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

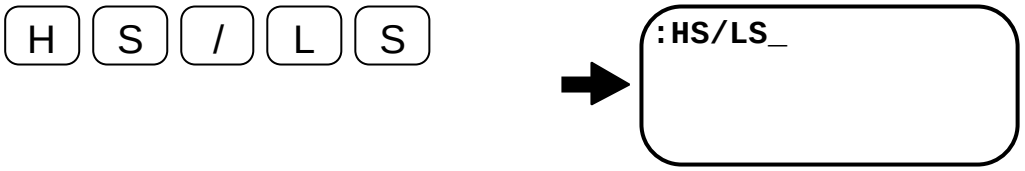
<Operation> Adjusting the Home limit switch position

1) Loosely mount the HLS sensor (Home limit switch) slightly preceding a point to be the Home position.

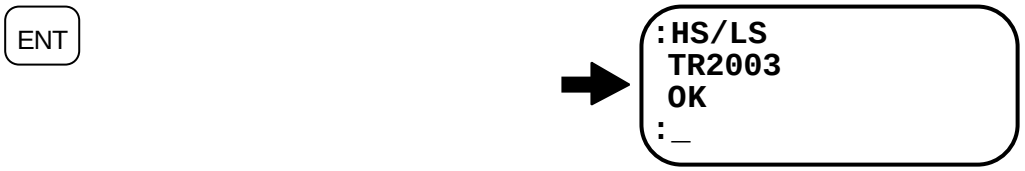
2) Check the wiring of the HLS sensor. Execute the IO command and check if the ESA25 Driver Unit is reading the HLS input correctly.

3) Adjust the position of the Home position sensor. First, make the Motor servo-on, then execute the HS/LS command. At this time, be careful that the Motor starts Home Return operation and thereby rotates. By using Handy Terminal, take the following steps:

(1)



(2) Press the ENT key to start Motor rotation.

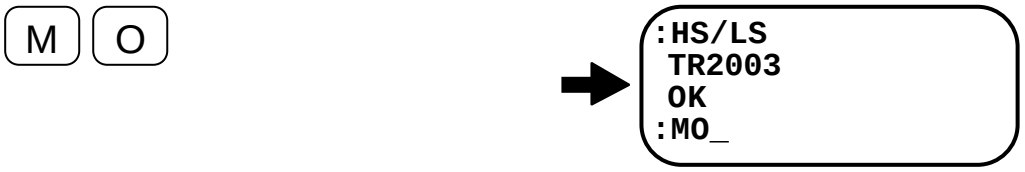


The Motor stops as soon as the HLS sensor goes ON. The Handy Terminal displays the TR value (i.e., number of pulses from the closest øZ rising edge) of the Motor's present position.
Check that this value is in the range of 1000 to 3000
If the TR value is not in this range, loosen the HLS sensor and move it CW or CCW direction. Repeat steps (1) and (2) until the TR value is within the above range.

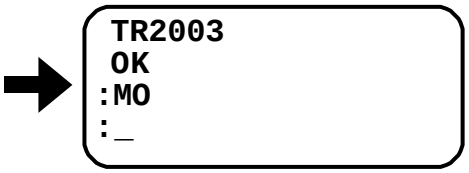
Caution : *When installing the HLS sensor, be sure to adjust its position as mentioned above. Otherwise, positioning may not be performed correctly.*

- Above procedures complete adjustment of Home limit sensor. Follow the procedures hereunder to adjust offset value of Home position.

(3) Input the MO command (servo-off command).



(4) Press the ENT key to execute the command and thereby turn off the Motor servo.

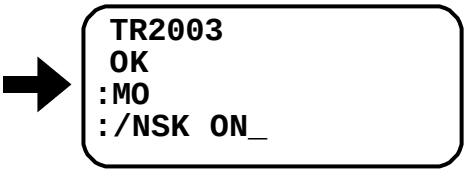


At this time, the Motor can be turned easily by hand. Turn the Motor to the desired position. Do not give the Motor more than one turn.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

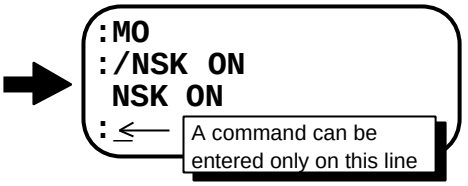
(5) Input the password.

/ N S K SP
O N



(6)

ENT



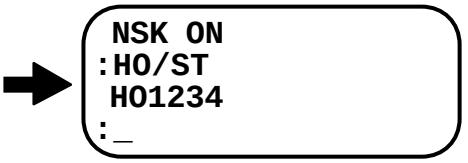
(7) The rotational position sensor calculates and writes the offset value of Home Return HO automatically when HO/ST command is executed.

H O / S T

(8) Press the ENT key to execute the command.

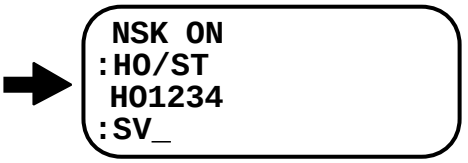
When the ":_" colon appears on the display, Home offset HO value is automatically calculated and set.

ENT



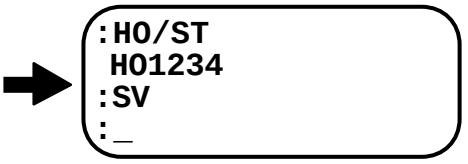
(9) Input the SV command (servo-on command.)

S V



(10) Press the ENT key to execute the command and thereby turn on the Motor servo.

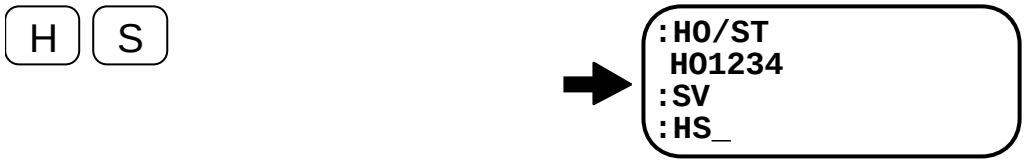
ENT



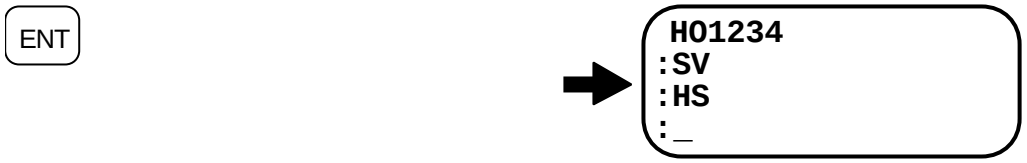
The ":_" colon appears when the Driver Unit is ready to accept another input.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

(11) Input the HS command (Home Return start command).



(12) Press the ENT key to execute the command and thereby start Home Return operation.



Check that the Motor stops at the desired Home position.

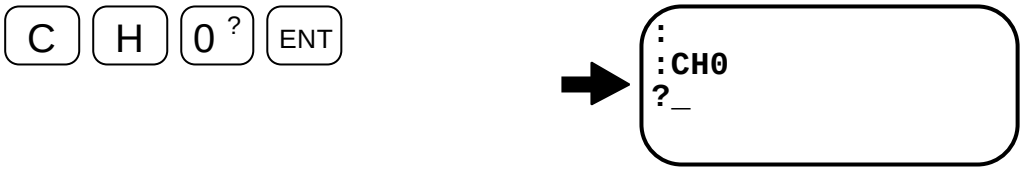
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

10.2.1.3. Programming Home Return Operation (example)

1 Programming Home return command in channel 0 (CH0)

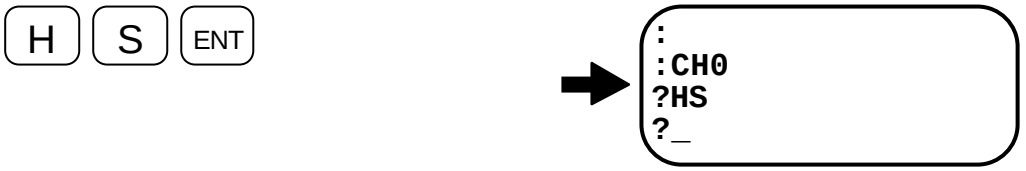
- Program the Home return command in a Programmable Indexer channel. Then, start the operation by activating the channel (i.e., RUN input ON).

1) Input the CH0 channel select command.

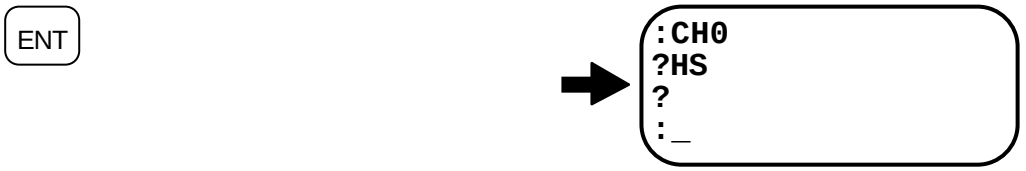


The "?" prompt appears to wait for data input. If data is already programmed in CH0, the registered data appears on the display.

2) Enter the Home return start command.



3) When the "?" prompt appears again, press the ENT key.



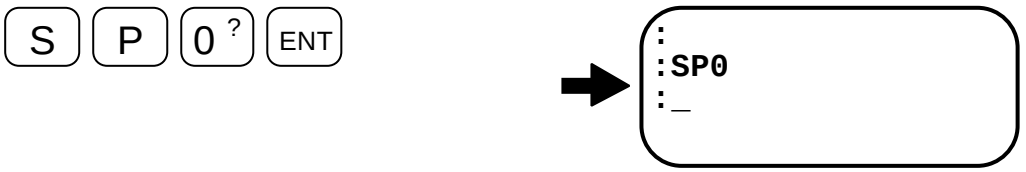
This completes the programming in CH0.

2 Home return trial operation

- Set Home return acceleration HA, Home return velocity HV and Home return offset HO.
- Then take the following steps to perform the trial operation.

1) Make the Motor servo-on.

2) Following the prompt (":"), input the execution command of internal programmable indexer channel.



The Motor starts Home return operation.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

10.2.2. Programmable Indexer

- Positioning command can be stored to the channel of the Driver Unit. Programmable Indexer is to execute the stored positioning program by selecting the channel via PRG0 ~ PRG5 input and RUN command.

- Set the system to servo-on. (SVON input ON)

- Select the channel. (Input PRG0 ~ PRG5, CN5 signal)

- By inputting RUN command ON, the Motor executes stored positioning program while IPOS output is closed. (When FW=0)

- While the Motor is performing the positioning operation, the RUN input is ignored.

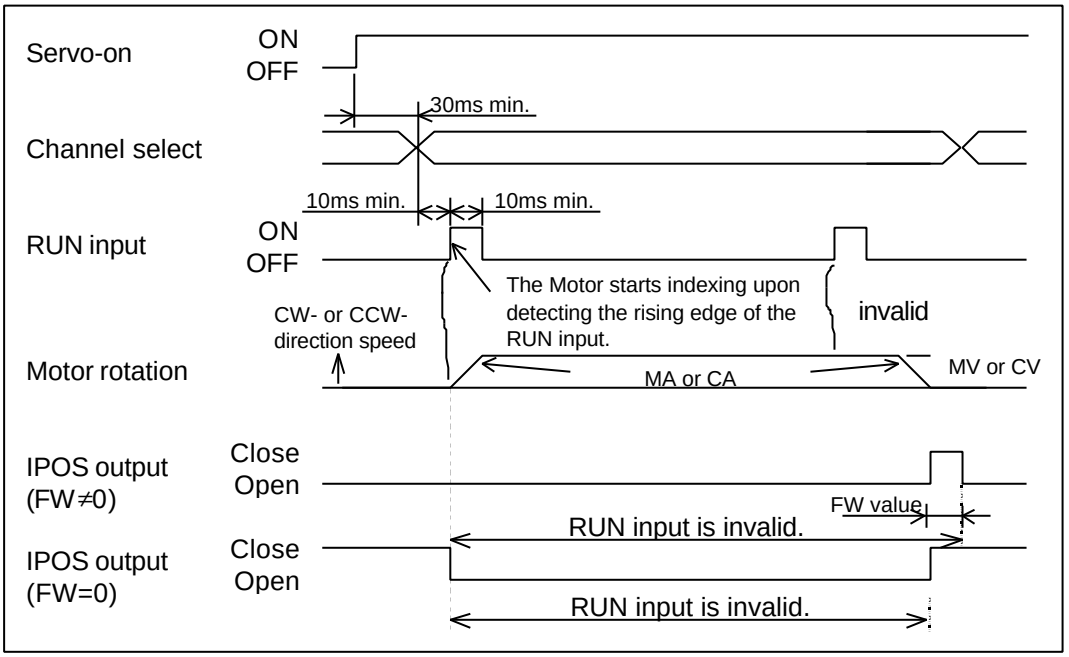
- Input the command “SP” to execute the Programmable Indexer. (Same function as inputting RUN command ON.)

  Type

  [S] [P] [m] [ENT]

  to execute the channel “m” program. (m : channel number)

Figure 10-4 : Programmable indexer command timing



- When an empty channel is selected, the program error alarm will be ON. (Refer to “14. Alarm.”)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

10.2.2.1. Programmable Indexer Channel Switching

- The channel to be executed is selected by combining the on and off of the PRG0 to PRG5 input of I/O connector CN5.

Table 10-5

Channel input	PRG 5	PRG 4	PRG 3	PRG 2	PRG 1	PRG 0
Channel 0	OFF	OFF	OFF	OFF	OFF	OFF
Channel 1	OFF	OFF	OFF	OFF	OFF	ON
Channel 2	OFF	OFF	OFF	OFF	ON	OFF
•	•	•	•	•	•	•
•	•	•	•	•	•	•
•	•	•	•	•	•	•
Channel 61	ON	ON	ON	ON	OFF	ON
Channel 62	ON	ON	ON	ON	ON	OFF
Channel 63	ON	ON	ON	ON	ON	ON

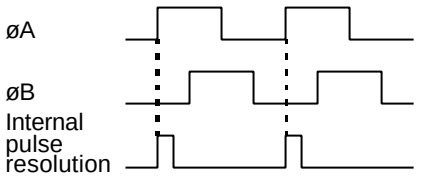
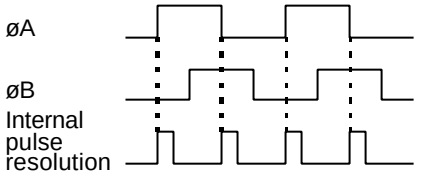
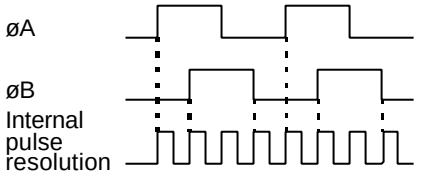
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

10.2.3. Pulse Train Command Operation

10.2.3.1. Pulse Train Signal Format

- Input a pulse train from CWP and CCWP of CN2 control I/O signal connector.
- Set the pulse train input signal format with the PC parameter (via the RS-232C communication). (The password must be input prior to the PC parameter setting.)

Table 10-6 : Signal format

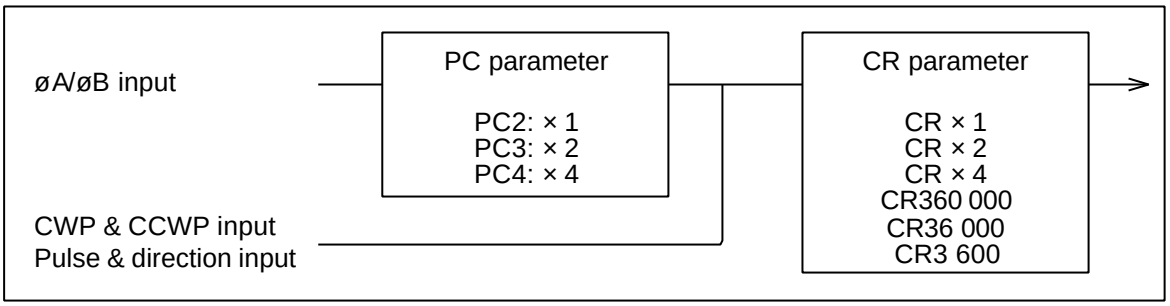
PC Parameter	CWP input	CCWP input	Function
PC0 (shipping set)	• Input CW pulse.	• Input CCW pulse.	CW & CCW format
PC1	• Input the direction. ON : CCW OFF : CW	• Input pulse train.	Pulse & direction format
PC2	• Input øB.	• Input øA.	øA/øB format (× 1) 
PC3			øA/øB format (× 2) 
PC4			øA/øB format (× 4) 

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

10.2.3.2. Pulse Train Resolution

- Set the resolution of the pulse train with the CR parameter (via RS-232C).
- In the case of øA/øB input, the pulse train resolution is multiplied by the PC parameter value, then by the CR parameter value.
- Refer to Table 10-7 for the concrete data of resolution.

Figure 10-5 : Pulse train resolution setting



1 YS, JS1, JS2 and RS Motor series

Table 10-7 : Pulse train resolution (YS, JS1, JS2 and RS Motor series)

CR Parameter	Resolver resolution	Resolution (pulses/360°) = number of pulses necessary for giving the Motor one turn		
		CW & CCW format, Step & Direction format	øA/øB format	
CR × 1 (Shipping set)	12-bit or automatic resolution switching	614 400	× 1	614 400
			× 2	307 200
			× 4	153 600
	10bit	153 600	× 1	153 600
			× 2	76 800
			× 4	38 400
CR × 2	12-bit or automatic resolution switching	307 200	× 1	307 200
			× 2	153 600
			× 4	76 800
	10bit	76 800	× 1	76 800
			× 2	38 400
			× 4	19 200
CR × 4	12-bit or automatic resolution switching	153 600	× 1	153 600
			× 2	76 800
			× 4	38 400
	10bit	38 400	× 1	38 400
			× 2	19 200
			× 4	9 600
CR360 000	12-bit/10-bit automatic resolution switching	360 000	× 1	360 000
			× 2	180 000
			× 4	90 000
CR36 000	12-bit/10-bit automatic resolution switching	36 000	× 1	36 000
			× 2	18 000
			× 4	9 000
CR3 600	12-bit/10-bit automatic resolution switching	3 600	× 1	3 600
			× 2	1 800
			× 4	900

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

2 SS Motor series

Table 10-8 : Pulse train resolution (SS Motor series)

CR Parameter	Resolver resolution	Resolution (pulses/360°) = number of pulses necessary for giving the Motor one turn		
		CW & CCW format, Step & Direction format	øA/øB format	
CR × 1 (Shipping set)	12-bit or automatic resolution switching	491 520	× 1	491 520
			× 2	245 760
			× 4	122 880
	10bit	122 880	× 1	122 880
			× 2	61 440
			× 4	30 720
CR × 2	12-bit or automatic resolution switching	245 760	× 1	245 760
			× 2	122 880
			× 4	61 440
	10bit	61 440	× 1	61 440
			× 2	30 720
			× 4	15 360
CR × 4	12-bit or automatic resolution switching	122 880	× 1	122 880
			× 2	61 440
			× 4	30 720
	10bit	30 720	× 1	30 720
			× 2	15 360
			× 4	7 680
CR360 000	12-bit/10-bit automatic resolution switching	360 000	× 1	360 000
			× 2	180 000
			× 4	90 000
CR36 000	12-bit/10-bit automatic resolution switching	36 000	× 1	36 000
			× 2	18 000
			× 4	9 000
CR3 600	12-bit/10-bit automatic resolution switching	3 600	× 1	3 600
			× 2	1 800
			× 4	900

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

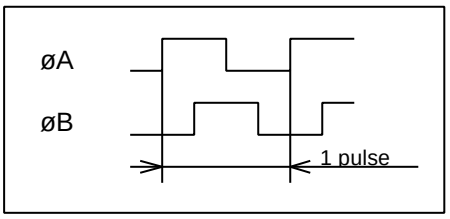
3 AS, BS and JS0 Motor series

Table 10-9 : Pulse train resolution (AS, BS and JS0)

CR Parameter	Resolver resolution	Resolution (pulses/360°) = number of pulses necessary for giving the Motor one turn		
		CW & CCW format, Step & Direction format	øA/øB format	
CR × 1 (Shipping set)	12-bit automatic resolution switching	409 600	× 1	409 600
			× 2	204 800
			× 4	102 400
	10bit	102 400	× 1	102 400
			× 2	51 200
			× 4	25 600
CR × 2	12-bit or automatic resolution switching	204 800	× 1	204 800
			× 2	102 400
			× 4	51 200
	10bit	51 200	× 1	51 200
			× 2	25 600
			× 4	12 800
CR × 4	12-bit or automatic resolution switching	102 400	× 1	102 400
			× 2	51 200
			× 4	25 600
	10bit	25 600	× 1	25 600
			× 2	12 800
			× 4	6 400
CR360 000	12-bit/10-bit automatic resolution switching	360 000	× 1	360 000
			× 2	180 000
			× 4	90 000
CR36 000	12-bit/10-bit automatic resolution switching	36 000	× 1	36 000
			× 2	18 000
			× 4	9 000
CR3 600	12-bit/10-bit automatic resolution switching	3 600	× 1	3 600
			× 2	1 800
			× 4	900

Note : • In the øA/øB format, one cycle of either øA or øB is defined as “one pulse”.

Figure 10-6



• The resolver resolution is set by the RR parameter (via RS-232C).

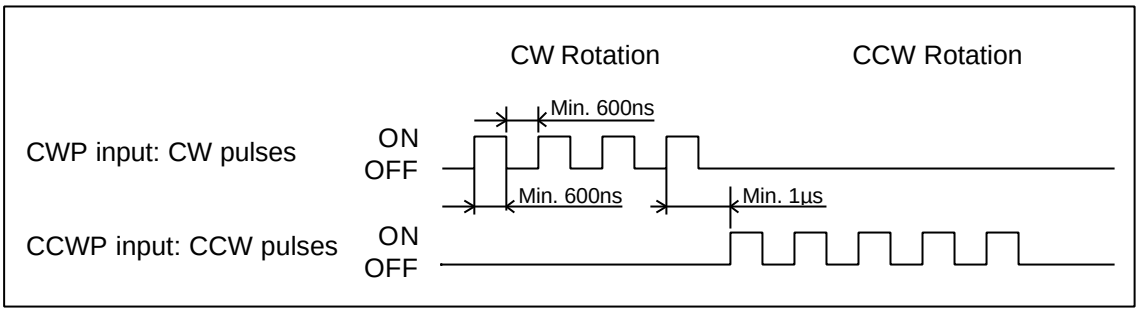
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

10.2.3.3. Input Timing

Caution : *The following specifies the conditions of pulse acceptance timing. Besides these conditions, the Motor operation is restricted by the maximum velocity. Do not input pulses which exceed the Motor's maximum velocity.*

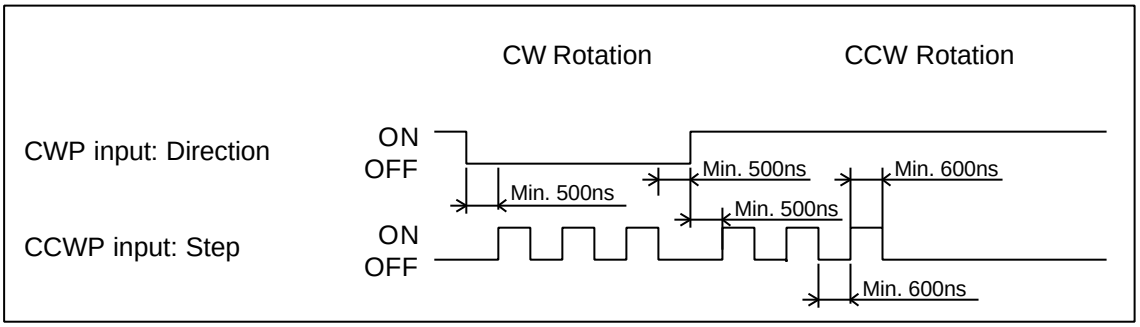
1 When PC is set to "0" (PC0)

Figure 10-7



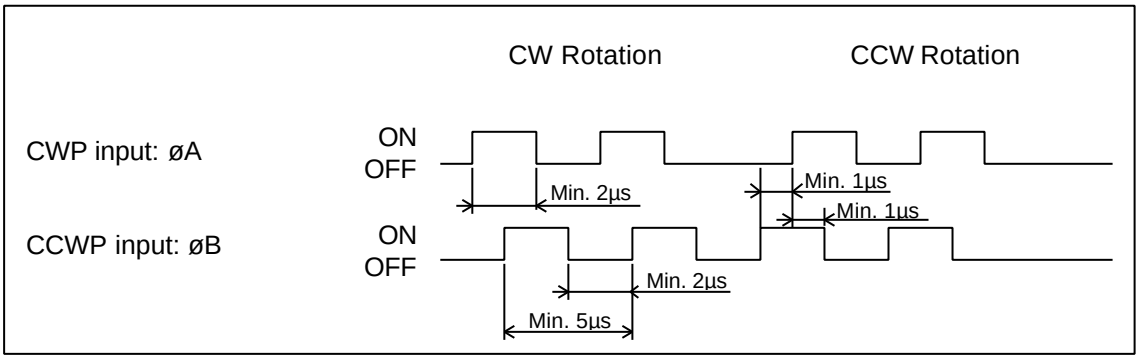
2 When PC is set to 1 (PC1)

Figure 10-8



3 When PC is set to 2~4 (PC2 ~ PC4)

Figure 10-9



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

10.2.4. RS-232C Position Commands

- You can execute indexing using RS-232C commands. The commands/parameters are shown below. Refer to “12. Commands and Parameter” for more details.

Table 10-10

Command/ parameter	Function
ID command	Sets the target and executes rotation (incremental/in the units of degree)
IR command	Sets the target and executes rotation (incremental/in the units of pulse)*
AD command	Sets the target and executes rotation (absolute/in the units of degree)
AR command	Sets the target and executes rotation (absolute/in the units of pulse)*
HS command	Starts Home Return.
HV parameter	Sets Home Return velocity.
HA parameter	Sets Home Return acceleration.
HO parameter	Sets the home offset value.
HD parameter	Specifies Home Return direction.
MA parameter	Sets the acceleration, for indexing.
MV parameter	Sets the velocity, for indexing.

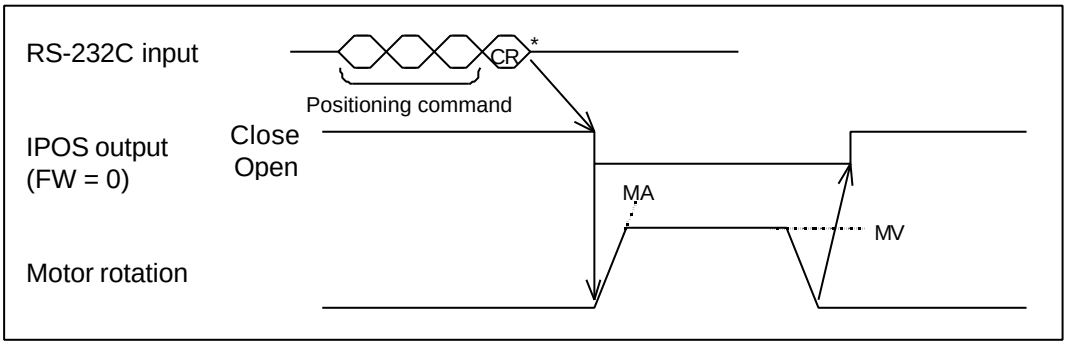
* : The table below lists the number of pulses per rotation of the IR command.

Table 10-11 : Motor type and resolution

Motor series	Resolution
YS, JS1, JS2, RS	614 400
SS	491 520
AS, BS, JS0	409 600

◆ Indexing Timing

Figure 10-10 : Indexing timing



* : CR stands for the carriage return code (0DH).

- Under SVON state, as soon as the command is input, the Motor starts indexing. The acceleration and velocity follow the settings of parameters “MA” and “MV”.

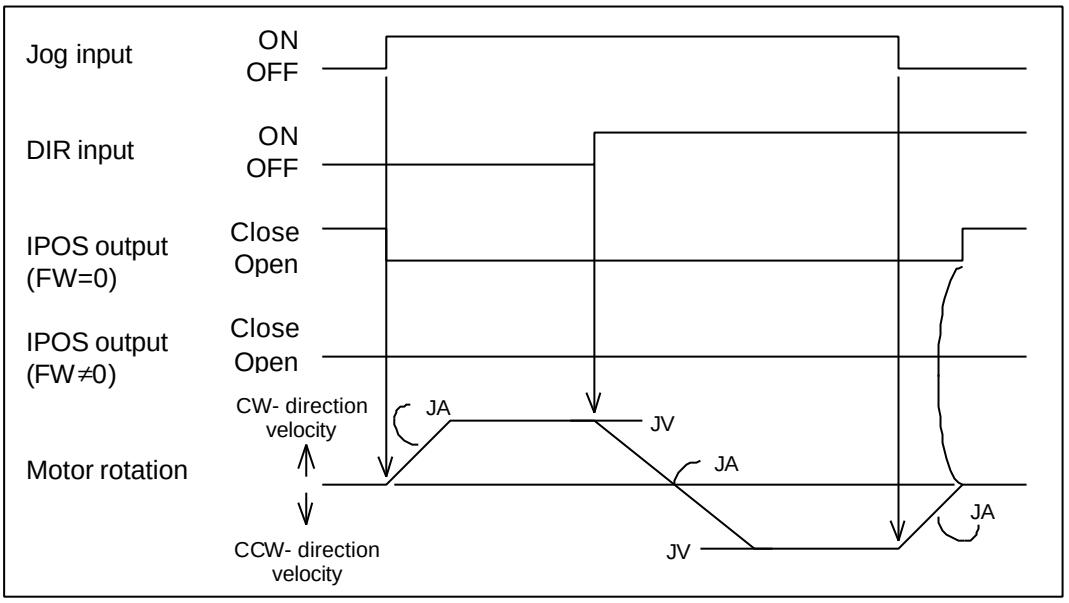
- If the position error counter value is within the in-position limit (set by IN parameter) after indexing, the IPOS output should be closed.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

10.2.5. Jog Operation

- Set system to servo-on. (SVON input ON)
- Turning on the Jog input makes the Motor to accelerate and rotate. The Motor keeps rotating while the Jog input remains on. When the Jog input is off, the Motor starts decelerating, then stops.
- When the DIR input is off, the Motor turns to CW. When the DIR input is on, it turns to CCW.
- Jog operation parameter
  JA : Jog acceleration
  JV : Jog velocity

Figure 10-11 : Jog operation timing



Caution : When the DIR input is switched during Motor rotation as shown in the above chart, the Motor decelerates, then reverses the direction of rotation.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

10.3. Velocity Control Mode Operation

- Velocity control mode can be set with the SL parameter.

  SL1 : Torque control mode

  SL2 : Velocity control mode

  SL3 : Position control mode

- Velocity control mode is available in the analog command input or RS-232C command input.

- The mode is switched by the parameter AC.

  AC0 : Analog command input invalid. DC command becomes valid.

  AC1 : Analog command input valid.
  When input voltage polarity is + (positive) : CCW direction

  AC-1 : Analog command input valid
  When input voltage polarity is - (negative) : CW direction

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

10.3.1. RS-232C Communication Command

- In the velocity control mode, the operation of the Motor can be executed through RS-232C communication command.

- Setting the parameter AC (AC0) makes the DC command valid.

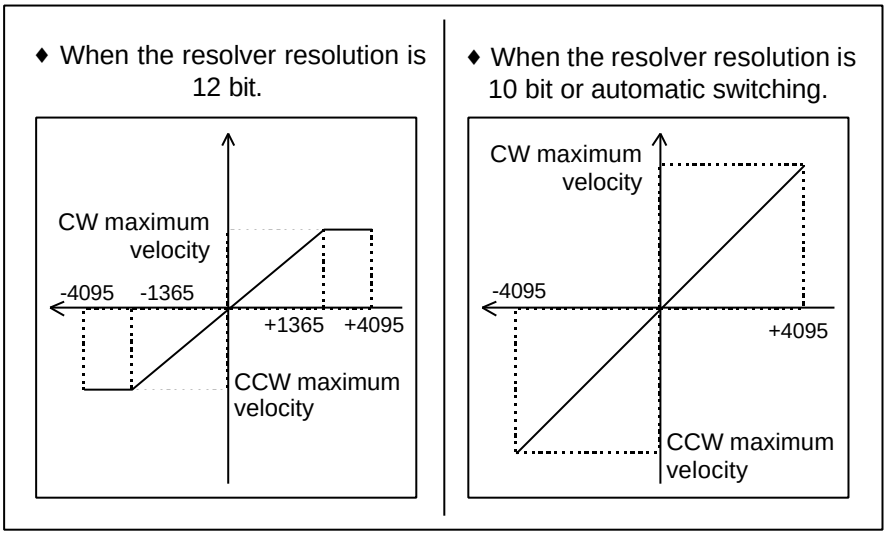
  Then input

  D C (data) ENT

  to control the Motor under the proportional speed to the command data value.

- The relation between the command DC data and velocity is shown in Figure 10-12.

Figure 10-12



Caution : When the polarity of the position scale is reversed by setting DI parameter, the polarity of DC command is also reversed.

Table 10-12 *[s^{-1}]*

Motor series	Maximum velocity	
	Resolver resolution: 12 bit	Resolver resolution: 10 bit or automatic switching
YS, JS1, JS2, RS	1	3
SS	1.25	3.75
AS, BS, JS0	1.5	4.5

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

10.3.2. Analog Velocity Command

- In the velocity control mode operation, the Motor may be controlled directly by inputting analog command.
  - ◊ Voltage range of analog command is ±10V. The offset adjustment may be performed with VR1 pod on the front panel of a Driver Unit.
  - ◊ Setting the parameter AC reverses the polarity of analog command voltage.
    AC1 : Analog voltage + : CCW
    AC -1 : Analog voltage + : CW
  - ◊ The parameter AGV changes the relation between analog voltage and velocity.

Table 10-13

DI data	AC data	Command voltage	Rotational direction
0	1	+	CCW
0	1	-	CW
0	-1	+	CW
0	-1	-	CCW
1	1	+	CW
1	1	-	CCW
1	-1	+	CCW
1	-1	-	CW

Figure 10-13: Command voltage and velocity

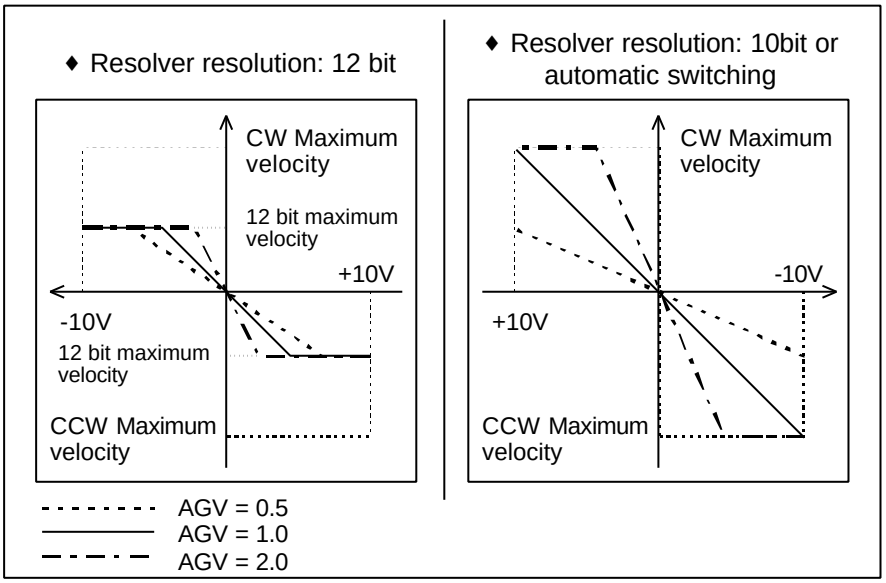


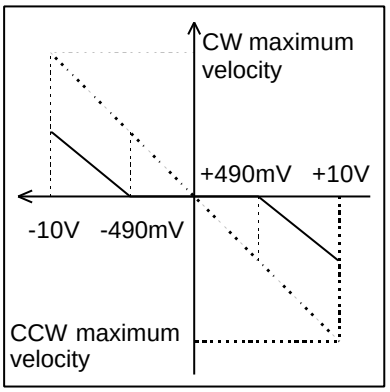
Table 10-14 *[s^{-1}]*

Motor series	Maximum velocity	
	Resolver resolution: 12 bit	Resolver resolution: 10 bit or automatic switching
YS, JS1, JS2, RS	1	3
SS	1.25	3.75
AS, BS, JS0	1.5	4.5

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

- The parameter DBA sets the dead band for analog command input.
  One unit of data sets ±4.9mV dead band.

Figure 10-14 : Example DBA100 (AC1)



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

10.4. Torque Control Mode Operation

- Torque control mode can be set with the SL parameter.

  SL1 : Torque control mode

  SL2 : Velocity control mode

  SL3 : Position control mode

- Torque control mode is available in the analog command input or RS-232C command input.

- The mode is switched by the parameter AC.

  AC0 : Analog command input invalid. DC command becomes valid.

  AC1 : Analog command input valid.
  When input voltage polarity is + (positive) : CCW direction

  AC-1 : Analog command input valid
  When input voltage polarity is - (negative) : CW direction

10.4.1. RS-232C Communication Command

- In the torque control mode, the operation of the Motor can be executed through RS-232C communication command.

- Setting the parameter AC (AC0) makes the DC command valid.

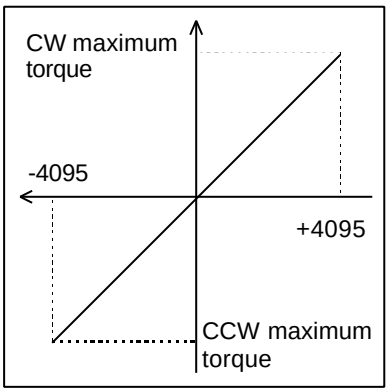
  Then input

  D C (data) ENT

  to control the Motor under the proportional speed to the command data value.

- The relation between the command DC data and torque is shown in Figure 10-15.

Figure 10-15



- Torque output varies with the Motor type.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

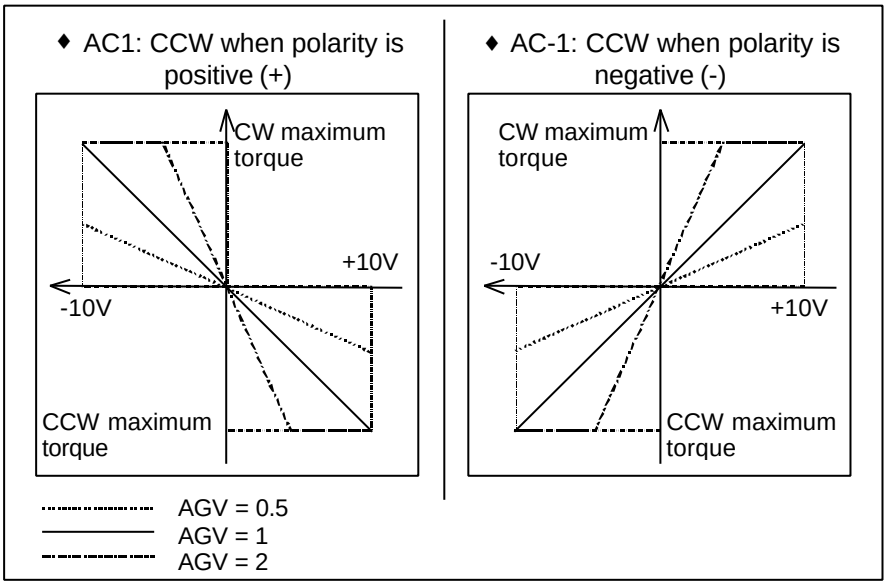
10.4.2. Analog Torque Command

- In the torque control mode operation, the Motor may be controlled directly by inputting analog command.
  - ◊ Voltage range of analog command is ±10V. The offset adjustment may be performed with VR1 pod on the front panel of a Driver Unit.
  - ◊ Setting the parameter AC reverses the polarity of analog command voltage.
    AC1 : Analog voltage + : CCW
    AC -1: Analog voltage + : CW
  - ◊ The parameter AGT changes the relation between analog voltage and torque.

Table 10-15

DI data	AC data	Command voltage	Rotational direction
0	1	+	CCW
0	1	-	CW
0	-1	+	CW
0	-1	-	CCW
1	1	+	CW
1	1	-	CCW
1	-1	+	CCW
1	-1	-	CW

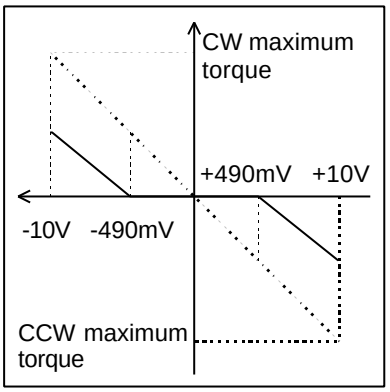
Figure 10-16



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

- The parameter DBA sets the dead band for analog command input.
  One unit of data sets ±4.9mV dead band.

Figure 10-17 : Example of DBA100 (AC1)



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

(Blank Page)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

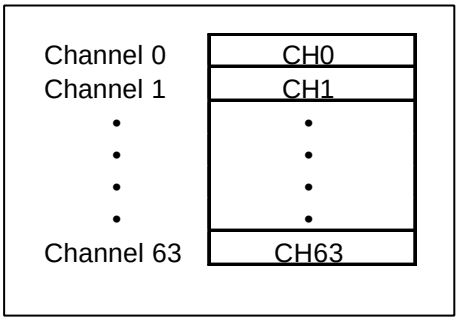
11. Programming

- The Driver Unit can store indexing profiles in its memory. To index along the stored indexing motion profile, external input (CN5 connector signal) is used. This function is called “Programmable Indexer”.

- The program of an indexing motion profile can be done via RS-232C communication. (Handy Terminal FHT11 or a personal computer.) The programming can be input only when the Motor is not indexing.

- The program area is shown in Figure 11-1. There are 64 channels ranging from channel 0 to 63.

Figure 11-1: Program area



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

11.1. Commands and Parameters

◆ Home Return

Command : HS
Condition setting : None

- Program Home Return operation.
- Command format : HS seq

  seq : sequence code (*, &) Refer to “Sequence Code” in the next page.
- The Motor rotates according to the values set by Home Return velocity HV, Home Return acceleration HA, Home Return near-zero velocity HZ, and to the direction set by Home Return direction HD.

  Caution : Direction of Home Return may be reversed using HD parameter.

  ◊ HD0 : CW direction

  ◊ HD1 : CCW detection (Shipping set)

*Program example

```
:CH0
HS
```

◆ Positioning

Command : AD, AR, ID, IR
Condition setting : CV, CA (Can be omitted.)

- Program the Indexing motion profile.

Table 11-1

Command format	Outline	Option
AD d1 d3 seq	• Absolute indexing, in the unit of degree. • The Motor turns to reach the d1 [× 0.01°] position of position scale.	Option code d3 /PL: CW direction /MI: CCW direction • When d3 is omitted, the Motor turns in the shortest-distance direction to reach the d1 position.
AR d1 d3 seq	• Absolute indexing in the unit of pulse. • The Motor turns to reach the d1 [pulse] position of position scale.	
ID d1 d2 seq	• Incremental indexing, in the unit of degree. • The Motor makes a d1 [× 0.01°] turn from the present position.	Option code d2 /n: (n <= 99) • When d2 is specified, the d1 value is equally divided by n. Single RUN input will make motor rotate by the divided amount. • When d2 is omitted, the d1 value will not be divided.
IR d1 d2 seq	• Incremental indexing in the unit of pulse • The Motor makes a d1 [pulse] turn from the present position.	

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

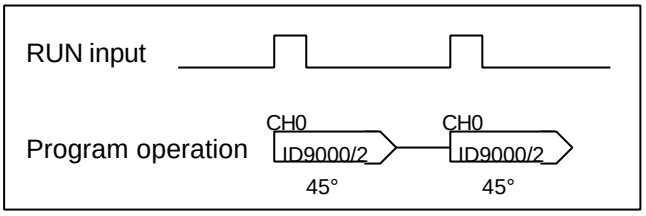
- seq stands for the sequence code (*, &), which sets the execution condition of the next channel in the sequence.

- Velocity CV and acceleration CA can be set in the same channel. When CV and CA are omitted, the Motor operates according to the values set by MV and MA respectively.

*Program example

```
:CH0
 ID9000/2
 CV1.5
 CA5
```

Figure 11-2



◆ **Jump**

Command : JP
Condition setting : None

- Unconditional jump command

- Control jumps to the specified channel, and its program will be executed continuously.

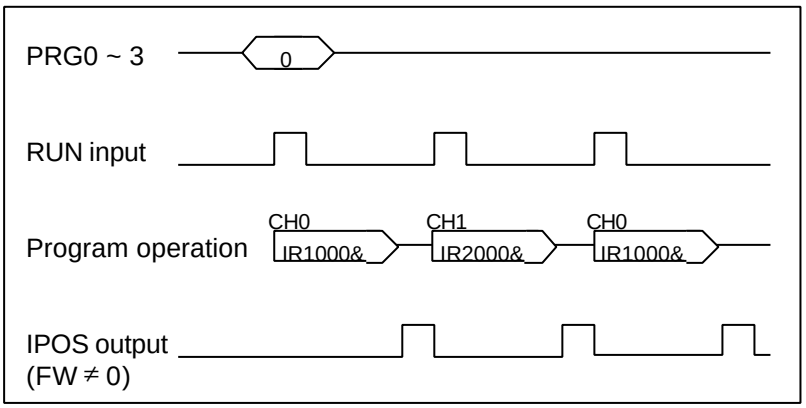
- Command format JPm

  m : Channel number to jump. (default : 0)

*Program example

```
:CH0
 IR1000&
:CH1
 IR2000&
:CH2
 JP0
```

Figure 11-3



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

◆ Sequence Code

Command : (HS), (AD), (AR), (ID), (IR)
Condition setting : *, &

- Add a sequence code to the command to execute the next channel continuously. In this case, you do not have to select a channel externally.

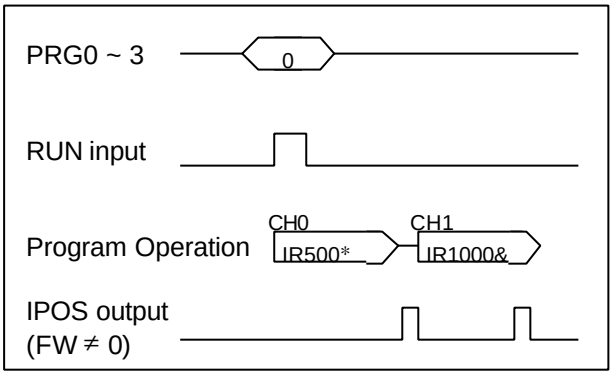
Table 11-2

Sequence code	IPOS output	Execution of the next channel
* : asterisk	Yes	Executes next program continuously after positioning is over.
& : ampersand	Yes	Stops after indexing, then waits for RUN command.

*Program example

```
:CH0
 IR500*
:CH1
 IR1000&
```

Figure 11-4



◆ Changing Sequence Code

Condition setting : OE

- OEseq changes the sequence code presently set.

* Program example

```
:CH0----------------------   Declare the channel whose sequence code is to be changed.
 AR9000&
 CV0.5
?OE* ----------------------   input [O] [E] [*] [ENT]
?
:TC0 ----------------------   Check the new data programmed in this channel.
 AR9000* ---------------      The sequence code has changed from "&" to "*".
 CV0.5
:
```


Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

11.2. Program Editing Command

Table 11-3 : Program editing command

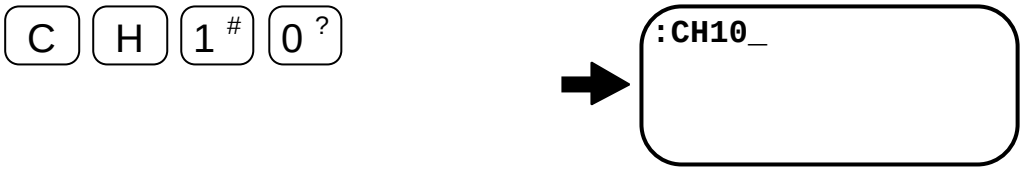
Editing	Command	Function
Change program settings	CH	• Typing C H m ENT declares the channel to be changed. (m : desired channel number) • The display shows the present program and waits for the changes. (The prompt is in "?" state.) • The last input program or data always becomes valid.
Display program	TC	• Typing T C m ENT displays the program in desired channel. (m: desired channel number) • When checking the program in all channels, type T C / A L ENT. • Type SP key to scroll to next channel.
Deleting program	CC	• Typing C C m ENT deletes the program in the desired channel. (m : desired channel number)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

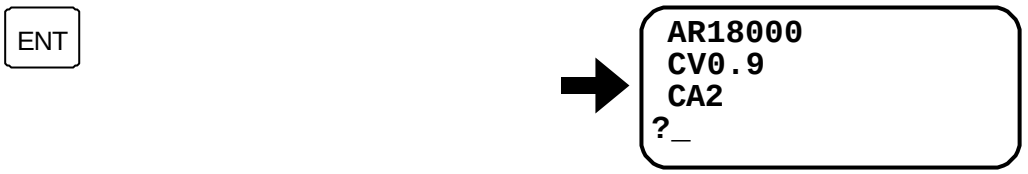
11.3. Inputting a Program

◆ Programming

1) Select a channel to be programmed.

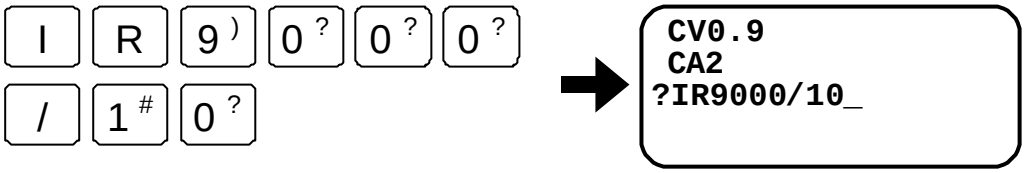


2) Press the enter key to execute a command.

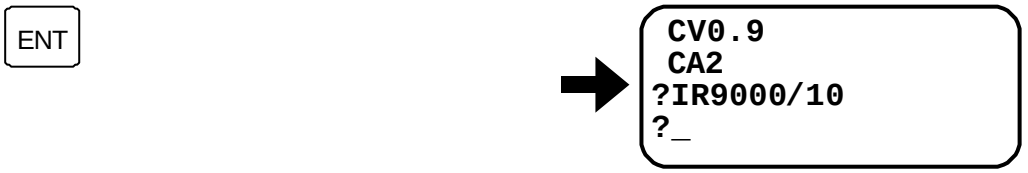


The motion profile presently programmed in the channel appears on the display.
The prompt "?" appears to wait for an input.

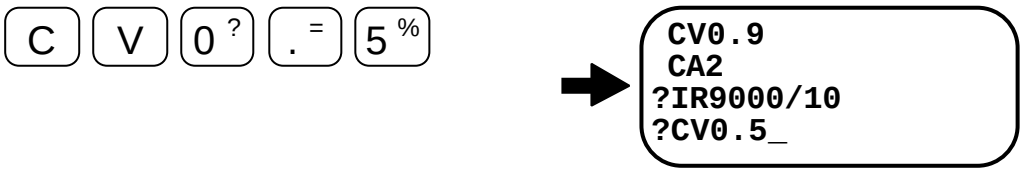
3) Program a command.



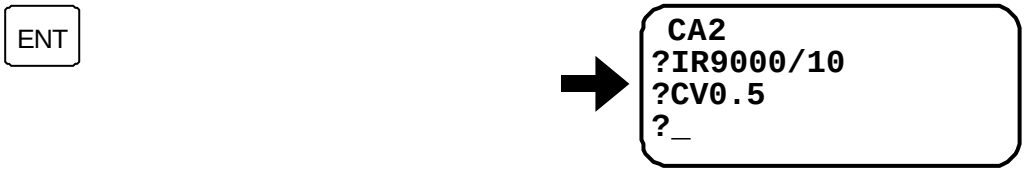
4) Enter a command. Press the enter key to set the command.



5) Set conditions according to the command.



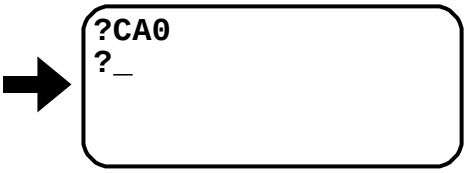
6) Press the enter to get the prompt "?" for next command. When incorrect data is input, reenter the correct data. When the same command with different data is input twice, the last input becomes valid.



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

7) Input “0” to cancel the condition.

C A 0 ? ENT



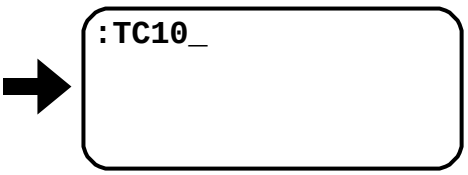
8) Press the ENT key only. The prompt returns to “:,” thereby completes the programming.

ENT

◆ Reading channel program

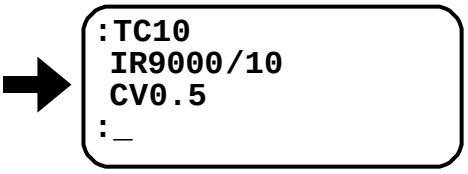
1) Declare the channel to be read and press the enter key.

T C 1 # 0 ?



2) The display shows the program of the selected channel.

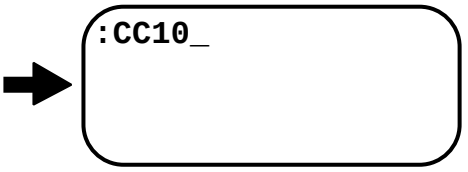
ENT



◆ Deleting the program

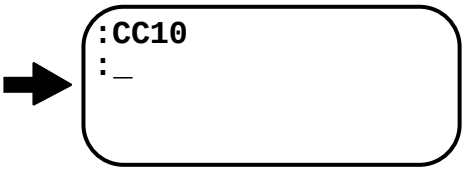
1) Declare the channel whose data is to be deleted.

C C 1 # 0 ?



2) Pressing the enter key deletes the data programmed in the channel.

ENT



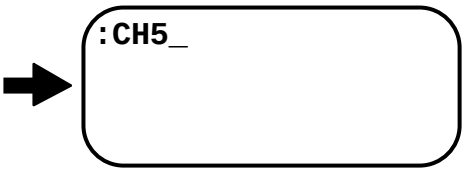
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

11.4. Sample Program

- Write the following motion profile in Channel 5.
  - ◊ Travel angle 30.00 degrees in the CCW direction
  - ◊ Acceleration CA : 5 [s^{-2}]
  - ◊ Velocity CV : 0.5 [s^{-1}]

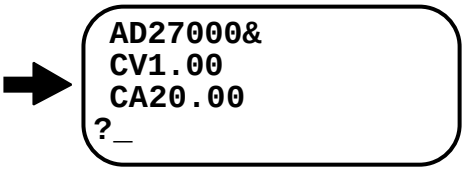
1) Check that the " : " prompt is displayed on the screen.

2) C H 5 %

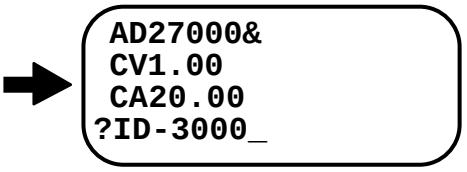


3) After pressing the ENT key, the data presently programmed in Channel 5 will be shown on the display.

ENT

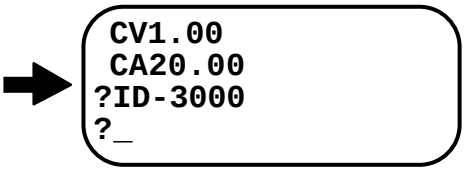


4) I D - + 3 < 0 ? 0 ? 0 ?

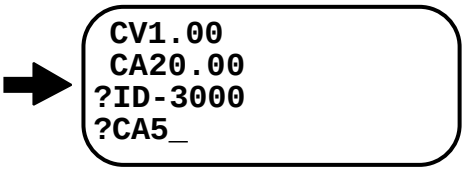


5) Press the ENT key to input value, and the "?" prompt appears again.

ENT

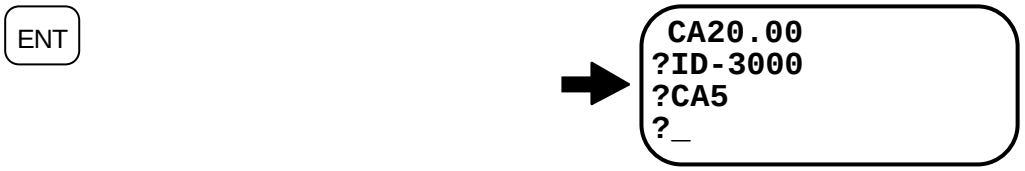


6) C A 5 %

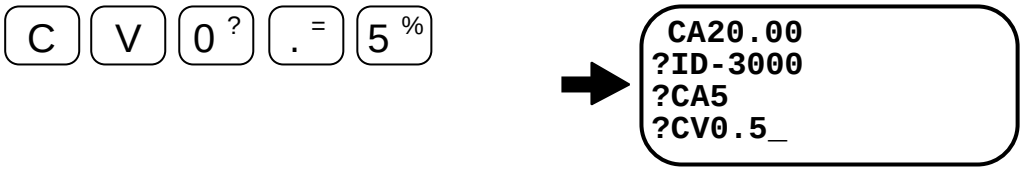


Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

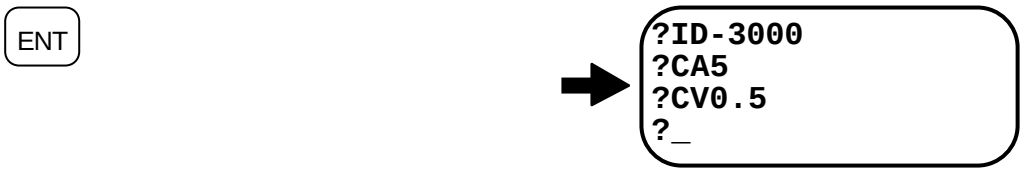
7) Press the ENT key to input value, and the "?" prompt appears again.



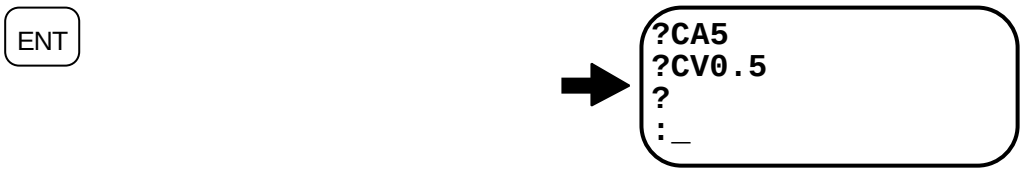
8)



9) Press the ENT key to input value, and the "?" prompt appears again.



10) Press the ENT key again to escape programming. This completes programming.



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

(Blank Page)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

12. Command and Parameter

- Connect Handy Terminal FHT11 to CN1 connector of the Driver Unit, then turn the power on. The system is in normal state if “NSK MEGA---” message is returned.
- Refer to “7. Handy Terminal Communication” for details.

12.1. List of Command and Parameter

- Tables 12-1, 12-2, and 12-3 are the lists of commands and parameters.
- Some parameters shown in the tables must be changed to unique values according to actual condition from the shipping set.
- Parameters parenthesized are properly set at the factory. If changing is necessary, contact your local NSK representative.

  * : (Current Setting) Set unique value to your application. We recommend to write down the set value for your future reference. You may need to refer to them when changing the operating conditions or readjusting the system. For your convenience, a parameter and program setting list is provided in Appendix 8 and 9 of this manual.

  ** : Setting differs with the Motor type and size.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Table 12-1 : YS, JS1, JS2 and RS Motor standard setting

Parameter	Name	Password	Shipping set	Data range	Current setting
PG	Position gain	-	0.100	0.010~1.000	
VG	Velocity gain	-	1.0	0.1~255.0	
VI	Velocity integrator frequency	-	1.0	0.10~63.00	
VM	Velocity integrator mode	✓	1	0, 1	
LG	Lower velocity gain.	-	0	0~100	
TL	Torque limit rate	✓	100	0~100	
FO	Low pass filter off velocity	-	0	0, 0.01~3.00	
FP	Low pass filter, primary	-	0	0, 10~500	
FS	Low pass filter, secondary	-	0	0, 10~500	
NP	Notch filter, primary	-	0	0, 10~500	
NS	Notch filter: secondary	-	0	0, 10~500	
DBP	Dead band, Position loop	✓	0	0, 1~4 095	
DBA	Dead band, Analog command input	✓	0	0~2 047	
ILV	Integration limit	✓	100.0	0.0~100.0	
FF	Feed forward gain	✓	0.0000	0.0000~1.0000	
FC	Friction compensation	✓	0	0~2 047	
CO	Position error counter over limit	-	50 000	1~99 999 999	
IN	In-position	-	100	0~99 999 999	
IS	In-position stability timer	-	0	0, 0.3~100	
FW	FIN width	-	1	0, 0.3~100	
VO	Velocity error over limit	✓	1 365	1~4 095	
VW	Velocity error over limit width	✓	100	0~1 000	
CR	Circular resolution	✓	X1	X1, X2, X4, 360 000, 36 000, 3 600	
PC	Pulse command	✓	0	0~4	
RR	Resolver resolution	✓	-1	-1, 0, 1	
FD	Feedback direction mode	✓	0	0, 1	
FZ	Feedback phase Z configuration	✓	0	0, 1	
FR	Feedback signal resolution	✓	0	0, 1	
PS	Position scale	✓	1	0, 1, 2~99	
DI	Direction inversion	✓	0	0, 1	
OTP	Over travel limit switch position	✓	0	-99 999 999~99 999 999	
OTM	Over travel limit switch position	✓	0	-99 999 999~99 999 999	
MV	Move velocity	-	1.0000	0.0001~3.0000	
MA	Move acceleration	-	1.00	0.01~80.00	
JV	Jog velocity	-	0.1000	0.0001~3.0000	
JA	Jog acceleration	-	1.00	0.01~80.00	
HV	Home return velocity	-	0.2000	0.0001~3.0000	
HA	Home return acceleration	-	1.00	0.01~80.00	
HZ	Home return / near zero velocity	-	0.0100	0.0001~0.2000	
OS	Home return	✓	4	1, 3, 4, 5	
HD	Hoe return direction	✓	1	0, 1	
HO	Home position offset	✓	0	-610 304~610 304	
(PA)	Origin setting mode	✓	(700)***	24~1 048	
(OL)	Overload limit	✓	**	0~100	
(RC)	Rated current	✓	**	0~100	
LR	Low torque ripple	✓	0	0, 1	
AB	I / O polarity	✓	X0X0XX00	0, 1, X	
NW	Chattering preventive timer	✓	2	0~4	
MM	Multi-line mode	✓	1	0, 1	
BM	Backspace code	✓	1	0, 1	
CM	Communication mode	✓	0	0, 1	
AN	Axis number	✓	0	0~15	
WM	Write mode to EEPROM	✓	0	0, 1	
SE	Serial error	✓	0	0, 1	
LO	Load inertia	✓	0.000	0.000~50.000	
SG	Servo gain adjust, minor	-	0	0~30	
(MT)	Factory use only	✓	**	-	
(RI)	Factory use only	✓	**	-	
(ZP)	Factory use only	✓	1.00	-	
(ZV)	Factory use only	✓	1.4	-	
SL	Set servo loop	✓	3	1, 2, 3	
AC	Analog command mode	✓	1	-1, 0, 1	
AGV	Analog command gain; velocity control mode	✓	1	0.10~2.00	
AGT	Analog command gain; torque control mode	✓	1	0.10~2.00	

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Table 12-2 : SS Motor standard setting

Parameter	Name	Password	Shipping set	Data range	Current setting
PG	Position gain	-	0.100	0.010~1.000	
VG	Velocity gain	-	1.0	0.1~255.0	
VI	Velocity integrator frequency	-	1.0	0.10~63.00	
VM	Velocity integrator mode	✓	1	0, 1	
LG	Lower velocity gain.	-	0	0~100	
TL	Torque limit rate	✓	100	0~100	
FO	Low pass filter off velocity	-	0	0, 0.01~3.75	
FP	Low pass filter, primary	-	0	0, 10~500	
FS	Low pass filter, secondary	-	0	0, 10~500	
NP	Notch filter, primary	-	0	0, 10~500	
NS	Notch filter: secondary	-	0	0, 10~500	
DBP	Dead band, Position loop	✓	0	0, 1~4 095	
DBA	Dead band, Analog command input	✓	0	0~2 047	
ILV	Integration limit	✓	100.0	0.0~100.0	
FF	Feed forward gain	✓	0.0000	0.0000~1.0000	
FC	Friction compensation	✓	0	0~2 047	
CO	Position error counter over limit	-	50 000	1~99 999 999	
IN	In-position	-	100	0~99 999 999	
IS	In-position stability timer	-	0	0, 0.3~100	
FW	FIN width	-	1	0, 0.3~100	
VO	Velocity error over limit	✓	1 365	1~4 095	
VW	Velocity error over limit width	✓	100	0~1 000	
CR	Circular resolution	✓	X1	X1, X2, X4, 360 000, 36 000, 3 600	
PC	Pulse command	✓	0	0~4	
RR	Resolver resolution	✓	-1	-1, 0, 1	
FD	Feedback direction mode	✓	0	0, 1	
FZ	Feedback phase Z configuration	✓	0	0, 1	
FR	Feedback signal resolution	✓	0	0, 1	
PS	Position scale	✓	1	0, 1, 2~99	
DI	Direction inversion	✓	0	0, 1	
OTP	Over travel limit switch position	✓	0	-99 999 999~99 999 999	
OTM	Over travel limit switch position	✓	0	-99 999 999~99 999 999	
MV	Move velocity	-	1.0000	0.0001~3.7500	
MA	Move acceleration	-	1.00	0.01~100.00	
JV	Jog velocity	-	0.1000	0.0001~3.7500	
JA	Jog acceleration	-	1.00	0.01~100.00	
HV	Home return velocity	-	0.2000	0.0001~3.7500	
HA	Home return acceleration	-	1.00	0.01~100.00	
HZ	Home return / near zero velocity	-	0.0001	0.0001~0.2000	
OS	Home return	✓	4	1, 3, 4, 5	
HD	Hoe return direction	✓	1	0, 1	
HO	Home position offset	✓	0	-487 424~487 424	
(PA)	Origin setting mode	✓	(700)***	24~1 048	
(OL)	Overload limit	✓	**	0~100	
(RC)	Rated current	✓	**	0~100	
LR	Low torque ripple	✓	0	0, 1	
AB	I / O polarity	✓	X0X0XX00	0, 1, X	
NW	Chattering preventive timer	✓	2	0~4	
MM	Multi-line mode	✓	1	0, 1	
BM	Backspace code	✓	1	0, 1	
CM	Communication mode	✓	0	0, 1	
AN	Axis number	✓	0	0~15	
WM	Write mode to EEPROM	✓	0	0, 1	
SE	Serial error	✓	0	0, 1	
LO	Load inertia	✓	0.000	0.000~50.000	
SG	Servo gain adjust, minor	-	0	0~30	
(MT)	Factory use only	✓	**	-	
(RI)	Factory use only	✓	**	-	
(ZP)	Factory use only	✓	1.00	-	
(ZV)	Factory use only	✓	1.4	-	
SL	Set servo loop	✓	3	1, 2, 3	
AC	Analog command mode	✓	1	-1, 0, 1	
AGV	Analog command gain; velocity control mode	✓	1	0.10~2.00	
AGT	Analog command gain; torque control mode	✓	1	0.10~2.00	

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Table 12-3 : AS, BS and JS0 Motor standard setting

Parameter	Name	Password	Shipping set	Data range	Current setting
PG	Position gain	-	0.1000	0.010~1.000	
VG	Velocity gain	-	1.0	0.1~255.0	
VI	Velocity integrator frequency	-	1.0	0.10~63.00	
VM	Velocity integrator mode	✓	1	0, 1	
LG	Lower velocity gain.	-	0	0~100	
TL	Torque limit rate	✓	100	0~100	
FO	Low pass filter off velocity	-	0	0, 0.01~4.50	
FP	Low pass filter, primary	-	0	0, 10~500	
FS	Low pass filter, secondary	-	0	0, 10~500	
NP	Notch filter, primary	-	0	0, 10~500	
NS	Notch filter: secondary	-	0	0, 10~500	
DBP	Dead band, Position loop	✓	0	0, 1~4 095	
DBA	Dead band, Analog command input	✓	0	0~2 047	
ILV	Integration limit	✓	100.0	0.0~100.0	
FF	Feed forward gain	✓	0.0000	0.0000~1.0000	
FC	Friction compensation	✓	0	0~2 047	
CO	Position error counter over limit	-	50 000	1~99 999 999	
IN	In-position	-	100	0~99 999 999	
IS	In-position stability timer	-	0	0, 0.3~100	
FW	FIN width	-	1	0, 0.3~100	
VO	Velocity error over limit	✓	1 365	1~4 095	
VW	Velocity error over limit width	✓	100	0~1 000	
CR	Circular resolution	✓	X1	X1, X2, X4, 360 000, 36 000, 3 600	
PC	Pulse command	✓	0	0~4	
RR	Resolver resolution	✓	-1	-1, 0, 1	
FD	Feedback direction mode	✓	0	0, 1	
FZ	Feedback phase Z configuration	✓	0	0, 1	
FR	Feedback signal resolution	✓	0	0, 1	
PS	Position scale	✓	1	0, 1, 2~99	
DI	Direction inversion	✓	0	0, 1	
OTP	Over travel limit switch position	✓	0	-99 999 999~99 999 999	
OTM	Over travel limit switch position	✓	0	-99 999 999~99 999 999	
MV	Move velocity	-	1.0000	0.0001~4.5000	
MA	Move acceleration	-	1.00	0.01~120.00	
JV	Jog velocity	-	0.1000	0.0001~4.5000	
JA	Jog acceleration	-	1.00	0.01~120.00	
HV	Home return velocity	-	0.2000	0.0001~4.5000	
HA	Home return acceleration	-	1.00	0.01~120.00	
HZ	Home return / near zero velocity	-	0.0100	0.0001~0.2000	
OS	Home return	✓	4	1, 3, 4, 5	
HD	Hoe return direction	✓	1	0, 1	
HO	Home position offset	✓	0	-405 504~405 504	
(PA)	Origin setting mode	✓	(700)***	24~1 048	
(OL)	Overload limit	✓	**	0~100	
(RC)	Rated current	✓	**	0~100	
LR	Low torque ripple	✓	0	0, 1	
AB	I / O polarity	✓	X0X0XX00	0, 1, X	
NW	Chattering preventive timer	✓	2	0~4	
MM	Multi-line mode	✓	1	0, 1	
BM	Backspace code	✓	1	0, 1	
CM	Communication mode	✓	0	0, 1	
AN	Axis number	✓	0	0~15	
WM	Write mode to EEPROM	✓	0	0, 1	
SE	Serial error	✓	0	0, 1	
LO	Load inertia	✓	0	0.000~50.000	
SG	Servo gain adjust, minor	-	0.000	0~30	
(MT)	Factory use only	✓	**	-	
(RI)	Factory use only	✓	**	-	
(ZP)	Factory use only	✓	1.00	-	
(ZV)	Factory use only	✓	1.4	-	
SL	Set servo loop	✓	3	1, 2, 3	
AC	Analog command mode	✓	1	-1, 0, 1	
AGV	Analog command gain; velocity control mode	✓	1	0.10~2.00	
AGT	Analog command gain; torque control mode	✓	1	0.10~2.00	

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

12.2. Glossary

- This section provides description and specifications of commands and parameters.
- "Shipping set" denotes a value which is set at the factory before shipment.
- "Default" denotes a value which is adopted when entering a command and parameter with no data. For example, if you input "DC" only, it will be recognized and executed as "DC0," because the default set of the "DC" command data is 0. If the command does not have a default set, then you cannot execute the command without data.
- The password must be entered before inputting a command marked with ★. Refer to "7.2.1. Password" for more details.

★ *AB : I/O polarity*

Format : AB n1 n2 n3 n4 n5 n6 n7 n8
Data : nn = 0 A contact (Normally open)
nn = 1 B contact (Normally close)
nn = X ◊ At the time of input:
The port set to X cannot change polarity.
◊ At the time of readout:
For the port which is shown as "X", the polarity cannot be change.
(Fixed to A contact.)
Shipping set : X0X0XX00 (all A contacts)
Default : Not available. Input all 8 digits.

- Sets the polarity of input command port.
- The ports of which polarity can be changed are EMST, HLS, OTP and OTM. The other ports are fixed to A contact.
- Set "X" for the port of which polarity cannot be changed. If "0" or "1" is input, the display shows "?" indicating a faulty input.
- Polarity setting can be read by "TS" or "?AB" command.
- The table below shows the data and port.

Data digit	n1	n2	n3	n4	n5	n6	n7	n8
CN2 pin No.	25	12	24	11	23	10	22	9
Signal name	SVON	EMST	IOFF	HLS	HOS	CLR	OTM	OTP

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

★ *AC : Analog Command Mode*

Format : AC data
Data range : -1, 0, 1
Shipping set : 1
Default : 0

- Set the validity (valid/invalid) and sign of the analog command input.
  AC0 : Analog command input invalid. DC command is valid.
  AC1 : Analog command input valid. Voltage + : CCW direction
  AC-1 : Analog command input valid. Voltage + : CW direction
- When the parameter DI is set to reverse the sign of coordinate, above sign is reversed again.
- Setting of "AC" command can be read by "TS" or "?AC" command.

AD : Absolute Positioning, Degree

Format : AD data1/data2
Data1 : Differs with parameter "PS" [0.01°]
Default data1 : 0
Data2 : PL, MI
Default data2 : Direction in which the move distance is shorter

- "data1" indicates a coordinate of the destination. This position, which can be read out by TP5 command, complies with the coordinate in the unit of the angle. Refer to "9.2.1. Position Scale" for details.
- "data1" range differs with "PS" setting.

	Data range (data1)
PS0	-99 999 999 ~ +99 999 999
PSn	0 ~ (36 000 × n) -1

n : n = 1-99, Shipping set : n = 1

- "data2" indicates the rotational direction. When the parameter "PS" is set to "0" (PS0), "data2" setting is invalid.
  1) PL : CW direction [When the parameter "DI" is set to "1" (DI1), the direction is reversed. (CCW)]
  2) MI : CCW direction [When the parameter "DI" is set to "1" (DI1), the direction is reversed. (CW)]
  3) Default:
     - Motor moves to the direction to where the shortest distance to the destination.
     - If position data of current position and destination is the same, moving distance is 0 (zero).
     - If "off-limit" area is set by software over travel limit, the Motor rotates in the direction to avoid the off-limit area regardless moving distance.
- This command has two functions depending on the usage.
  1) If it is entered in the normal standby condition (the prompt is ":"), it serves as a positioning command.
  2) If it is entered right after inputting CH command (channel selection) and the system is in "command receiving " state (the prompt is "?"), it is regarded as a program data to the specified channel.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

★ *AG : Analog Command Gain*

Format : AGV data
AGT data
Data range : 0.10 ~ 2.00
Shipping set : 1 (both AGV and AGT)
Default : Not available

- This command sets the analog command gain in the velocity and torque control mode.
  AGV : Analog command gain in velocity control mode
  AGT : Analog command gain in torque control mode

- Actual gain value is in proportion to the velocity or torque command.

  ◊ Example
  When AGV0.5:

  Actual velocity command = Velocity command input ×0.5

- "TS" or "?AG" command reports the current setting.

★ *AN : Axis Number*

Format : AN data
Data range : 0 ~ 15
Shipping set : 0
Default : 0

- Sets the axis number in the daisy chain communication mode.

- "TS" command or "?AN" command reports the current setting.

- Refer to "9.3.4. Daisy Chain Communication."

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

AR : Absolute Positioning, Resolver

Format : AR data1/data2
Data1 : Differs with the parameter "PS" setting and Motor type.
Default data1 : 0
Data2 : PL, MI
Default data2 : Direction in which the move distance is shorter

- "data1" indicates the position of the destination. The position, which may be read out by TP2 command, complies with a coordinates in the unit of pulses. Refer to "9.2.1. Position Scale" for details.

- Format of "data1" range differs with the parameter "PS" setting and the Motor series.

	Data range (data1)		
	YS, JS1, JS2, RS	SS	AS, BS, JS0
PS0	-99 999 999 ~ +99 999 999	-99 999 999 ~ +99 999 999	-99 999 999 ~ +99 999 999
PSn	0 ~ (614 400 × n) -1	0 ~ (491 520 × n) -1	0 ~ (409 600 × n) -1

n = 1 ~ 99, Shipping set : n = 1

- "data 2" indicates the rotational direction. When PS parameter is set to "0 (zero)", the "data 2" is invalid.

  1) PL : CW direction (When the parameter "DI1" is set, the direction is CCW.)
  2) MI : CCW direction (When the parameter "DI1" is set, the direction is CW.)
  3) If the "data 2" is omitted, the Motor rotates to the shortest direction to the destination. (If the current position is the same as the destination, the Motor does not rotate.)

- This command has two functions depending on the usage.

  1) If it is entered in the normal standby condition, it serves as a positioning command. (when the prompt is " : __")
  2) If it is entered just after the CH command, it can be used as a program data of designated channel.
     (when the prompt is " ? __")

AS : Ask Daisy Chain Status

Format : AS

- In daisy chain communication, AS reads out the state of axis numbers for respective Driver Units.

- The "AS" command is executed automatically when power is turned on in the daisy chain communication mode.

- After the "AS" command is executed, the Driver Unit of axis 0 is always selected.

AT : Automatic Tuning

Format : AT

- Executes "automatic tuning" to set proper servo parameters and acceleration.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

AX : Axis Select

Format : AX data
Data : 0 ~ 15
Shipping set : 0
Default : 0

- When communicating in daisy chain, AX selects the one of the Driver Units. Selected Driver Unit sends a confirmation signal back to the RS-232C terminal.
- Confirmation message is "ACC. AXn" (n = selected Driver Unit number). The Driver Unit of axis 0 is always selected when power is turned on.
- Report command "TS" or "?AX" is valid when daisy chain communication is active.
- If "AX" is input when daisy chain is not active, an error message will be given back.
- Also if "TS" or "?AX" command is input when daisy chain is not active, an error message will be given.

Caution : Do not select any Driver Unit that is not connected. Otherwise, operation may hang up. To return to the normal state, press the BS key first, then the number of a connected Driver Unit.

★ *AZ : Absolute Zero Position Set*

Format : AZ

- When the Motor is stopping at any position, "AZ" command makes the current position to the origin of the coordinate.

★ *BM : Backspace Mode*

Format : BM data
Data : 0 or 1
Shipping set : 1
Default : 0

- BM changes the function of the BS key.

  BM0 : A press of the BS key cancels an entered character string on a line.

  BM1 : A press of the BS key deletes a character.

- TS or "?BM" command reports the current setting.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

CA : Channel Acceleration

Format : CA data
Data
Motor series
YS, JS1, JS2, RS : 0, 0.01 ~ 80.00 [s^{-2}]
SS : 0, 0.01 ~ 100.00 [s^{-2}]
AS, BS, JS0 : 0, 0.01 ~ 120.00 [s^{-2}]
Default : 0

- This command is used to specify the rotational acceleration of a given channel of the internal program of the designated channel.
- The CA command is only valid when the CH command designates a channel to be programmed and the Driver Unit outputs "?__" for command input.
- If no setting is made in a channel (or 0 is specified), the rotational acceleration specified with an "MA" command is valid.
- "TC" command reports the current setting.
  - ◊ If "0 (zero)" is set, no response is displayed.

CC : Clear Channel

Format : CC data1
Data1 : 0 ~ 15
Data1 default : 0

- CC deletes the program data of a channel specified in "data."

CH : Channel Select

Format : CH data
Data1 : 0 ~ 15
Data1 default : 0

- This command is to select the channel to input program.
- The input program can be read with "TC" command.

Caution *: Input program when the system is servo-off state.*

CL : Clear Alarm

Format : CL

- "CL" command clears "excess error", "software thermal" and "program error" alarms. (Other alarms cannot be cleared with "CL" command.)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

★ *CM : Communication Mode*

Format : CM data
Data : 0 or 1
Shipping set : 0
Default : 0

- CM selects the RS-232C communication mode.
  CM0 : Standard
  CM1 : Daisy chain communication
- The CM parameter set at the time of power-on is valid.
- To change the communication mode, change the CM parameter, turn off the power, then turn it on again.
- "TS" or "?CM" command reports the current setting.

CO : Position Error Counter Over Limit

Format : CO data
Data : 1 ~ 99 999 999 [pulse]
Shipping set : 50 000
Default : Not available

- CO sets the position error counter value at which the excess position error alarm is to be detected.
- When the position error exceeds the set value, the Driver Unit outputs the excess position error alarm and opens the DRDY output circuit.
- "TS" or "?CO" command reports the current setting.

★ *CR : Circular Resolution*

Format : CR data
Data : X1, X2, X4, 360 000, 36 000, 3 600
Shipping set : X1
Default : Not available

- Use to specify the pulse train input resolution.
- For the details, refer to "10.2.3. Pulse Train Command Operation."
- The resolution changes immediately after CR data is specified.
- "TS" or "?CR" command reports the current setting.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

CV : Channel Velocity

Format : CV data
Data
Motor series
YS, JS1, JS2, RS : 0, 0.0001 ~ 3.0000 [s^{-1}]
SS : 0, 0.0001 ~ 3.7500 [s^{-1}]
AS, BS, JS0 : 0, 0.0001 ~ 4.5000 [s^{-1}]
Default : 0

- This command is used to specify the rotational velocity of each channel of the Programmable Indexer.
- If no setting is made in a channel (or 0 is specified), the rotational velocity specified with an "MV" command is valid
- The CV command is only valid when the CH command designates a channel to be programmed and the Driver Unit outputs "?__" for command input.
  - ◊ If it is input under normal standby state (the prompt is ":"), an alarm will arise.
- "TC" command reports the current setting.
  - ◊ If "0 (zero)" is set, no response is displayed.

★ *DB : Dead Band*

Format : DBA data
DBP Data
Data DBA : 0, 1 ~ 2 047
Data DBP : 0, 1 ~ 4 095
Shipping set : 0 (for both DBA and DBP)
Default : 0

- Sets a dead band for the position loop and analog command input.
  DBP : Position loop dead band
  DBA : Analog command input dead band
- "TS" or "?DB" command reports current setting.
- For the details, refer to "9.2.6. Dead Band Setting : DBP."
- For the details of DBA, refer to "10.3.2. Analog Velocity Command" or "10.4.2. Analog Torque Command."

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

DC : Digital RS-232C Command

Format : DC data
Data : -4 095 ~ 4 095 (data polarity in + value : CW direction)
Default : 0

- This command is to input directly the operation command through RS-232C communication interface in velocity or torque control mode.
  However, the use of this command shall be limited to an ordinal operation or a testing operation of the Motor due to sluggish response.

- If "DC" command is input when an analog command ("AC" command) is valid, "DC INHIBITED" message will be given and the command will be invalidated.

- The data of this command is cleared to "0" in following state.

  1) Servo off
  2) Emergency stop
  3) Overtravel limit
  4) Control mode selection
  5) Analog command is valid.

Caution *: When the position scale direction is reversed by the parameter DI, the sign of data of DC command is also reversed.*

★ *DI : Direction Inversion*

Format : DI data
Data : 0 or 1
Shipping set : 0
Default : 0

- Switches the position scale coordinate counting direction.

- For the details, refer to "9.2.1. Position Scale."

★ *FC : Friction Compensation*

Format : FC data
Data : 0 ~ 2 047
Shipping set : 0
Default : 0

- "FC" is used to specify a compensation value to cancel rotational static friction of the Motor.

- If 0 is specified in "data," the function is deactivated.

- Parameter FC can be obtained with the formula shown below.

$$\text{FC "data"} = 2\,047 \times \frac{\text{Static friction torque}}{\text{Motor maximum torque}}$$

- The setting can be read with "TS" or "?FC" command.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

★ *FD : Feed Back Direction Mode*

Format : FD data
Data : 0, 1
Shipping set : 0
Default : 0

- Reverses the output timing between øA and øB of the position feedback signal.
  FD0 : Standard; øA is leading phase in CW direction.
  FD1 : Reverse; øB is leading phase in CW direction.

- "TS" or "?FD" command reports the current setting.

★ *FF : Feed Forward Gain*

Format : FF data
Data : 0.0000 ~ 1.0000
Shipping set : 0
Default : 0

- FF sets the feed forward compensation gain.

- Setting 0 cancels the feed forward compensation function.

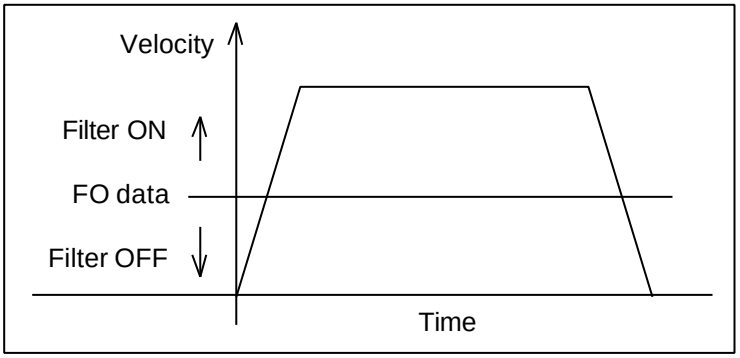
- "TS" or "?FF" command reports the current setting.

FO : Low-pass Filter OFF Velocity

Format : FO data
Data
Motor series
YS, JS1, JS2, RS : 0, 0.01 ~ 3.00 [s^{-1}]
SS : 0, 0.01 ~ 3.75 [s^{-1}]
AS, BS, JS0 : 0, 0.01 ~ 4.50 [s^{-1}]
Shipping set : 0
Default : 0

- Sets the low pass filters (parameter FP and FS), depending upon velocity.

- FO data sets the velocity threshold which turns ON and OFF the low pass filters.



- When this function is set, it is possible to lower the resonance noise level without affecting on the settling time.

- When "FO" is set to 0, the function is invalid. (The low-pass filters are always active.)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

FP : Low-pass Filter, Primary

Format : FP data
Data : 0, 10 ~ 500 [Hz] or /AJ (Adjusting mode)
Shipping set : 0
Default : 0

- FP sets the frequency of the primary low-pass filter of the velocity loop.
- When 0 is input, the velocity-loop primary low-pass filter is set to "off." At this time, [PRI.LPF OFF] appears on the display.
- When data other than 0 (i,e, 10 ~ 500) is input, the frequency specified by the data is set.
- The set value can be read by the "TS" command and "?FP."
- Inputting FP/AJ can set to fine adjusting mode.

★ *FR : Feedback Signal Resolution*

Format : FR data
Data : 0 or 1
Shipping set : 0
Default : 0

- Sets the resolution specification of the position feedback signal øA and øB.
  FR0 : 10-bit resolution specification
  FR1 : 12-bit resolution specification
- For more details, refer to "4.2.3. Functional Specification."
- Set FR0 when the resolver resolution is set to 10-bit or automatic resolution switching by the RR parameter. If FR1 is set, øA and øB will not be output.
- Both FR0 and FR1 can be selected when the resolver resolution is set to 12-bit specification by the RR parameter.
- "TS" or "?FR" command reports the current setting.

FS : Low-pass Filter, Secondary

Format : FS data
Data : 0, 10 ~ 500 [Hz] or /AJ (Adjusting mode)
Shipping set : 0
Default : 0

- Sets the frequency of the secondary low-pass filter of the velocity loop.
- When 0 is input, the velocity-loop secondary low-pass filter is set to "off." At this time, [SEC.LPF OFF] appears on the display.
- When data other than 0 (i,e, 10 ~ 500) is input, the frequency specified by the data is set.
- The set value can be read by the "TS" command and "?FS."
- Inputting FS/AJ can set to fine adjusting mode.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

FW : FIN Width

Format : FW data
Data : 0 or 0.3 ~ 100 [0.1 second]
Shipping set : 1
Default : 0

- Sets the time length of IPOS output. Unit is 0.1 sec.
- If it is set to FW1, the time length of the IPOS output will be 0.1 sec.
- If it is set to FW0, IPOS output is in standard state and always closed when the position error counter value is less than the "IN" setting.
- When it is set to FW0.3 ~ FW100, IPOS output is closed for the moment as set when the position error counter value is less than the "IN" value.
- Refer to "9.1.8. In-Position Output" for the output timing.
- "TS" or "?FW" command reports the current setting.
- Set FW0 when the system is performing the pulse train command operation.

★ *FZ : Feedback Phase Z Configuration*

Format : FZ data
Data : 0 or 1
Shipping set : 0
Default : 0

- FZ selects the output format of the position feedback signal CHZ (CN2 output).
  FZ0 : Outputs the øZ signal from CHZ.
  FZ1 : Outputs MSB of the digital position signal from CHZ.
- Refer to "9.1.9. Position Feedback Signal" for the output timing of the øZ signal or MSB.
- "TS" or "?FZ" command reports the current setting.

HA : Home Return Acceleration

Format : HA data
Data
Motor series
YS, JS1, JS2, RS : 0, 0.01 ~ 80 [s^{-2}]
SS : 0, 0.01 ~ 100 [s^{-2}]
AS, BS, JS0 : 0, 0.01 ~ 120 [s^{-2}]
Shipping set : 1.00 [s^{-2}]
Default : Not available

- Sets Home Return acceleration.
- "TS" or "?HA" command reports the current setting.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

★ *HD : Home Return Direction*

Format : HD data
Data : 0 or 1
Shipping set : 1
Default : 0

- Refer to "10.2.1. Home Return" for details
- HD0 : Home Return in the CW direction
- HD1 : Home Return in the CCW direction

★ *HO : Home Offset*

Format : HO data or /ST
Data
Motor series
YS, JS1, JS2, RS : -610 304 ~ 610 304 (pulse)
SS : -487 424 ~ 487 424 (pulse)
AS, BS, JS0 : -405 504 ~ 405 504 (pulse)
Shipping set : 0
Default : 0

- In Home return, this command sets the pulse counts to stop the Motor after the resolver hits its reference point (øZ* ON) for the first time after Home position limit switch input (HLS: CN2) is OFF. Refer to "7.2. Home Return."
- "TS" or "?HO" command reports the current setting.

HS : Home Return Start

Format : HS opt
: opt = default ----- Normal Home Return
: opt = /LS ---------- Adjust limit position

- Starts Home Return.
- Input HS/LS to adjust position of the home position proximaty sensor.
- For more details, refer to "10.2.1.2. Adjusting Home Position Switch and Home Offset Value."

HV : Home Return Velocity

Format : HV data
Data
Motor series
YS, JS1, JS2, RS : 0.0001 ~ 3.0000 [s^{-1}]
SS : 0.0001 ~ 3.7500 [s^{-1}]
AS, BS, JS0 : 0.0001 ~ 4.5000 [s^{-1}]
Shipping set : 0.2000
Default : Not available

- Sets Home Return velocity.
- "TS" or "?HV" command reports the current setting.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

HZ : Home Return Near-Zero Velocity

Format : HZ data
Data : 0.0100 ~ 0.2000 [s^{-1}]
Shipping set : 0.0100 [s^{-1}]
Default : Not available

- Sets Home Return near-zero velocity.
- "TS" or "?HZ" command reports the current setting.

ID : Incremental Positioning, Degree

Format : ID data
Data : -99 999 999 ~ +99 999 999 [0.01°]
Default : 0

- Executes the incremental positioning command (in unit of degrees) in the RS-232C communication operation.
- Data is in the unit of 0.01°.
- The data sign specifies the direction of rotation.
  data > 0 : plus direction (CW)
  data < 0 : minus direction (CCW)
  Example : ID-10000 : The Motor turns 100° in the minus direction

★ *ILV : Integration Limit*

Format : ILV data
Data : 0.0 ~ 100.0 [%]
Shipping set : 100

- Provides the velocity loop integrator with a limit.
- For more details, refer to "9.2.5. Integrator Limit : ILV."
- "TS" or "?ILV" command reports the current setting.

IN : In-position

Format : IN data
Data : 0 ~ 99 999 999 [pulse]
Shipping set : 100
Default : 0

- Specify an in-position width (criteria to detect completion of positioning). If the position error counter reaches a value below the IN set value, the IPOS signal is output.
- "TS" or "?IN" command reports the current setting.
- When the resolver is set to 10-bit resolution, the resolution becomes one-fourth of the 12-bit setting. Therefore, only a multiple of 4 can be set (valid) as IN data.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

IO : Input /Output Monitor

Format : IO data opt
Data : data = default or 0----- Indicates CN2 input/output status.
data = 1 ---------- Indicates CN2 input/output status. (B contact input indication is reversed.)
data = 2 ---------- Indicates input/output status in programmed operation.
data = 3 ---------- Indicates input/output status in Jog operation.
Option code
: opt = default ---------- Indicates current status in one shot.
opt = /RP---------- Reading is repeated automatically.

- Indicates the status of control input/output signal (ON/OFF , open/close) by 1 or 0.
  1 : Input ON, output closed
  0 : Input OFF, output opened

- To terminate IO/RP repeated automatic reading, press BS key.

- For more details, refer to "9.1.10.2. Monitoring I/O State (IO)."

IR : Incremental Positioning, Resolver

Format : IR data
Data : -99 999 999 ~ +99 999 999 [pulse]
Default : 0

- Executes the incremental positioning command (in the unit of pulse) in the RS-232C communication operation.

- The data sign specifies the direction of rotation (movement).
  data > 0 : plus direction (CW direction)
  data < 0 : minus direction (CCW direction)

IS : In-position Stability Timer

Format : IS data
Data : 0 or 0.3 ~ 100.0 [0.1 sec]
Default : 0

- Specifies the output condition of the positioning completion signal (IPOS).
  IS0 : The IPOS output closes in positioning if the value of the position error counter is within the IN set range.
  IS data (data ≠ 0) : The IPOS output closes in positioning if the value of the position error counter is stable within the IN set range for the time specified in IS. The timer value is specified in "data" in units of 0.1 second. It may be 0.03 to 10 seconds if data is specified as 0.3 to 100.

- "TS" or "?IS" command reports the current setting.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

JA : Jog Acceleration

Format : JA data
Data
Motor series
YS, JS1, JS2, RS : 0.01 ~ 80.00 [s^{-2}]
SS : 0.01 ~ 100.00 [s^{-2}]
AS, BS, JS0 : 0.01 ~ 120.00 [s^{-2}]
Shipping set : 1
Default : Not available

- Sets the acceleration for Jog operation.
- "TS" or "?JA" command reports the current setting.

JP : Jump

Format : JP data
Data : 0 ~ 63
Default : 0

- "JP" is used to specify the destination channel of unconditional jump in an internal program.
- If a channel with a "JP" command is executed, processing program jumps to channel specified by "data" unconditionally.
- The "JP" command may be input under the condition where a channel to be programmed is selected with a "CH" command, the Driver Unit outputs "?," and the system waits for a command. If it is entered in the normal standby state, an error occurs. (normal standby state : A colon ":" is displayed)
- "TC" command reports current setting.

JV : Jog Velocity

Format : JV data
Data
Motor series
YS, JS1, JS2, RS : 0.0001 ~ 3.0000 [s^{-1}]
SS : 0.0001 ~ 3.7500 [s^{-1}]
AS, BS, JS0 : 0.0001 ~ 4.5000 [s^{-1}]
Shipping set : 0.1
Default : 0

- Sets the velocity for Jog operation.
- "TS" or "?JV" command reports the current setting.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

LG : Lower Velocity Gain

Format : LG data
Data : 0 ~ 100 (%)
Shipping set : 0
Default : Not available

- Sets velocity loop proportional gain (VG) lowering ratio when IOFF input is activated.
- However, LG is invalidated when an excessive position error alarm is issued.
- The Motor does not generate torque if LG remains LG0 when IOFF turns ON.

★ *LO : Load Inertia*

Format : LO data
Data range : 0.000 ~ 50.000 [kgm^2]
Shipping set : 0
Default : 0

- This is to set the actual load inertia. The data may be entered when the load inertia is known prior to perform automatic tuning.
  - ◊ The automatic tuning sets actual load inertia LO automatically.
- TS command or ?LO reports the current setting.
- Data of PG, VG, VI and MA will be automatically adjusted when LO data is changed.
- Data of LO is cleared to 0 when one of the data of PG, VG or VI is changed.

★ *LR : Low Torque Ripple*

Format : LR data
Data range : 0, 1
Shipping set : 0
Default : 0

- Selects the characteristics of the Motor torque output.
  0 : Standard
  1 : Low torque ripple. (the maximum Motor torque will be lowered)
- "TS" or "?LR" command reports the current setting.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

MA : Move Acceleration

Format : MA data
Data
Motor series
YS, JS1, JS2, RS : 0.01 ~ 80.00 [s^{-2}] or /AJ (Adjust mode)
SS : 0.01 ~ 100.00 [s^{-2}] or /AJ (Adjust mode)
AS, BS, JS0 : 0.01 ~ 120.00 [s^{-2}] or /AJ (Adjust mode)
Shipping set : 1.00 [s^{-2}]
Default : Not available

- Sets the rotational acceleration of the RS-232C communication positioning.
- "TS" or "?MA" command reports the current setting.
- "MA/AJ" command gets into fine adjusting mode.

MI : Read Motor ID

Format : MI

- MI indicates reference number of the system ROM and the torque ROM.

★ *MM : Multi-line Mode*

Format : MM data
Data : 0, 1
Shipping set : 1
Default : 0

- Sets the display format of commands or parameters to be read out by "TA," "TC" and "TS" commands.
- "MM0" reports all contents continuously.
- When "MM1" is input, the display reports the setting pausing at each item. At this time, the semicolon ";" appears the end of command or parameter.

  [Example : MA0.01;]

- Only the space key and backspace key are valid when the Motor is pausing. Press the space key to step to the next parameter and press the backspace key to quit from the report. The colon ":" appears to wait for next command.
- "TS" or "?MM" reports the current setting.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

MN : Monitor

Format : MN data
Data : 0 ~ 7
Shipping set : 0
Default : 0

- Selects and sets the condition of the analog monitor.
- The setting is not backed-up in the memory. “MN” command must be entered when monitoring is required.
- Setting can be read by “?MN” command.
- The condition of monitor is shown in the table below.

MN data	Monitor output
MN0	Velocity
MN1	Velocity command
MN2	Velocity error
MN3	Torque command
MN4	Phase C current command
MN5	Position command
MN6	Position error (± 127 pulses / ± 10V)
MN7	Position error (± 16 383 pulses / ± 10V)

MO : Motor Off

Format : MO

- When the SVON input (CN2) is ON and the Motor is in the servo-on state, inputting the “MO” command turns the Motor servo off.
- To activate the Motor servo again, input the “SV” command or the “MS” command.
- When the “MS” command is input, the Motor gets in the servo-on state. This also clears the inputted operation command previously.

MS : Motor Stop

Format : MS

- When the “MS” command is input during the execution of an operation, the Motor abandons the programs and stops. At this time, the Motor is in the servo-on state.
- The programs specified before the Motor stop are cleared. If the “MO” command is input to turn off the Motor servo, inputting the MS command sets the Motor to servo-on again. This also clears the programs being executed before the input of the “MO” command.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

★ *MT : Factory Use Only*

Shipping set : Already set properly for every system.

Caution : *Do not change the setting since the parameter is properly set at the plant.*

- This parameter is set at the factory befor shipping.
- "TS" or "?MT" command reports the current setting.

MV : Move Velocity

Format : MV data
Data
Motor series
YS, JS1, JS2, RS : 0.0001 ~ 3.0000 [s^{-1}] or /AJ (Adjust mode)
SS : 0.0001 ~ 3.7500 [s^{-1}] or /AJ (Adjust mode)
AS, BS, JS0 : 0.0001 ~ 4.5000 [s^{-1}] or /AJ (Adjust mode)
Shipping set : 1.0000 [s^{-1}]
Default : Not available

- Sets the rotational velocity of the Motor in the RS-232C communication positioning command.
- "TS" or "?MV" command reports the current setting.
- "MV/AJ" command sets to adjusting mode.

NP : Notch Filter, Primary (primary notch filter frequency)

Format : NP data
Data : 0 or 10 ~ 500 [Hz] or /AJ (Adjusting mode)
Shipping set : 0
Default : 0

- NP is used to specify the frequency of the primary notch filter of the velocity loop.
- If 0 is specified, the primary notch filter of the velocity loop is deactivated. In such a case, "PRI.NF OFF" is displayed.
- If a value other than 0 (i.e., 10 ~ 500) is entered, the value is adopted as the frequency.
- "TS" or "?NP" command reports the current setting.
- "NP/AJ" command sets to adjusting mode.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

NS : Notch Filter, Secondary (secondary notch filter frequency)

Format : NS data
Data : 0, 10 ~ 500 [HZ] or /AJ (adjust mode)
Shipping set : 0
Default : 0

- NS data sets frequency of secondary notch filter.
- If "0" is specified, the 2nd stage notch filter will be set to OFF. In such a case the display shows "SEC.NF.OFF."
- If the data other than "0" (i.e., 10 ~ 500) is specified, the frequency sets to data.
- Command TS or ?NS reports the current setting.
- NS/AJ starts adjusting program.

★ *NW : Neglect Width*

Format : NW data
Data : 0 ~ 4
Shipping set : 2
Default : 0

- RUN and HOS are rising edge-triggered inputs. To protect against chattering due to physical contact, the NW parameter sets a timer length to confirm the input as the current level detection.
  Timer = data × 2.8 [ms]
- "TS" or "?NW" command reports the current setting.

OE : Sequence Option Edit

Format : OE data
Data : * or &
Default : Not available

- OE changes the sequence code of a program already specified in a channel.
- When this command is entered under the following conditions, the sequence code that is set previously to the specified channel will be changed to the data of this command.
  - ◊ CH command specifies a channel to be programmed.
  - ◊ The Driver Unit outputs "?" indicating that it is ready for a command.
- "data" indicates the sequence code. Adding the sequence code enables to execute the positioning of next channel without selecting it externally.
  - ◊ * After the positioning is over, "IPOS" signal is output and execute the next channel's program.
  - ◊ & After the positioning is over, outputs "IPOS" signal and stops. Then executes the next channel's program when "RUN" command is input.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

★ *OG : Origin Set*

Format : OG

Caution : *This "OG" command is for factory use only. Do not change the setting.*

★ *OL : Overload Limit*

Format : OL data
Data : 0 ~ 100
Shipping set : Unique value for each System
Default : 0

- Do not change the OL setting. OL is properly set for each System. If it needs to be changed, contact NSK.
- If 0 is specified, the Driver Unit displays "THERMAL OFF" to indicate it is deactivated.
- "TS" or "?OL" command reports the current setting.

★ *OS : Origin Setting Mode*

Format : OS data
Data : 1, 3, 4, 5
Shipping set : 4
Default : Not available

- Sets the "Home Return" mode.
  - OS1 : Completes "Home Return" at where "HLS" input goes OFF after entering "HLS" ON range.
  - OS3 : Completes "Home Return" at where the Motor advances "HO" value after going out from "HLS" ON range.
  - OS4 : Completes "Home Return" at where the Motor advances for "HO" value after entering "HLS" ON range.
  - OS5 : Completes "Home Return" at where "HLS" input goes ON.
- Refer to "10.2.1. Home Return" for OS4 sequential chart.
- The Home Return setting can be checked with "TS" or "?OS" command.

★ *OTP*
: Overtravel Limit Switch Position
★ *OTM*

Format : OTP data, OTM data
Data : -99 999 999 ~ +99 999 999 [pulse]
Shipping set : 0 (OTP, OTM)
Default : 0

- Sets the software overtravel limit values in the position scale.
  - OTP : Sets the overtravel limit value in the plus direction in the units of pulse.
  - OTM : Sets the overtravel limit value in the minus direction in the units of pulse.
- "OTP/ST" and "OTM/ST" command enables to set the position by teaching.
  (For more details, refer to "9.1.5.2. Software Over-travel Limit Switch.")
- "TS" or "?OTP", "?OTM" command reports the current setting.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

★ *PA : Phase Adjust*

Format : PA data
Data : 24 ~ 1 048
Shipping set : 700 (However, for non-interchangeable Motor, data varies with individual Motor.)
Default : Not available

- Sets the compensation value of the resolver installation position.
- The resolver is set to the optimum installation position before shipment. Do not input PA in normal use.
- "TS" or "?PA" command reports the current setting.

★ *PC : Pulse Command*

Format : PC data
Data : 0 ~ 4
Shipping set : 0
Default : 0

- Sets the format of the pulse train input.
  PC0 : CW & CCW format
  PC1 : Pulse & direction format
  PC2 : øA/øB input, single format
  PC3 : øA/øB input, duplex format
  PC4 : øA/øB input, quadrature format
- "TS" or "?PC" command reports the current setting.

PG : Position Gain

Format : PG data
Data : 0.010 ~ 1.000 or /AJ (adjusting mode)
Shipping set : 0.100
Default : Not available

- Sets proportional gain of the position loop.
- "TS" or "?PG" command reports the current setting.
- "PG/AJ" command sets to the fine adjusting mode.
- PG/AJ starts adjust mode.
- It is automatically adjusted when LO data or SG data is changed.
- LO data and SG data are cleared to 0 when PG data is changed.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

★ *PH : Programmed Home Return*

Format : PH data
Data : 0 ---- Automatic Home Return invalid
1 ---- Execute Home Return only once when the power is turned on and the Home position is not certain.
2 ---- Execute Home Return every time before execution of the programmed operation.
Shipping set : 0
Default : 0

- This is to execute Home Return operation automatically before the programmed operation is performed.
- The setting makes “HS” command unnecessary and can save one channel program area.
- “TC/AL” or “?PH” command reports the current setting.

★ *PS : Position Scale*

Format : PS data
Data : 0, 1, 2 ~ 99
Shipping set : 1
Default : 0

- Specifies the internal position scale system of the Megatorque Motor system.
  PS0 : Linear position scale
  PS1 : Single-rotation position scale
  PS2 to 99 : Multi-rotation position scale
- “For more details, refer to “9.2.1. Position Scale.”
- “TS” or “?PS” command reports the current setting.

RA : Read Analog Command

Format : RA
RA/RP

- Reads the analog command value when an analog command is valid.
- “RA” input reports reading only once. “RA/RP” reports the reading continuously. To quit from the continuous reading, press [BS] key.
- “RA INHIBITED” message will be returned when an analog command is invalid.
- The report is a decimal number in -2 048 ~ 2 047.
- The report includes the result of dead band setting when “DBA” (dead band) is set to an analog command.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

★ *RC : Rated Current (Software Thermal)*

Format : RC data
Data : 0 ~ 100
Shipping set : Unique value for each Motor
Default : 0

- Do not change the RC setting. RC is properly set for each Motor. If it needs to be changed, contact NSK.
- "TS" or "?RC" command reports the current setting.

★ *RI : Factory Use Only*

Shipping set : Set properly to each Motor.

Caution : *Do not change setting. It is properly set for each Motor at the factory.*

- "TS" or "?RI" reports the current setting.

★ *RR : Resolver Resolution*

Format : RR data
Data : 0, 1, -1
Shipping set : -1
Default : 0

- Sets the resolution of the resolver.
  RR0 : 10-bit setting
  RR1 : 12-bit setting
  RR-1 : Automatic resolution switching
- For details of resolution, refer to "4.2.3. Functional Specification."
- "TS" or "?RR" command reports the current setting.

★ *SE : Serial Error*

Format : SE data
Data range : 0, 1
Shipping set : 0
Default : 0

- Set DRDY output format when RS-232C serial communication is abnormal.
  SE0: DRDY output close (Motor state: normal)
  SE1: DRDY output open (Motor state: servo lock)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

SG : Servo Gain Adjust, Minor

Format : SG data
Data : 0 ~ 30 [HZ] or /AJ (Adjust mode)
Shipping set : 0
Default : Not available

- Sets position loop gain in the automatic tuning minor adjustment.
- When "SG" value is changed, the parameter "PG" (position loop proportional gain), "VG" (velocity loop proportional gain) and "VI" (velocity loop integration frequency) parameter settings will be automatically renewed.
- "SG/AJ" command starts the fine adjusting program.
- "TS" or "?SG" reports the current setting.
- If PG, VG or VI is changed, SG setting is cleared to 0.

★ *SI : Set Initial Parameters*

Format : SI/data
Data range : None, AL, SY, YS
Default : None

- Resets parameters to the shipping set value.
- The "SI" command can be input only immediately after inputting the password and when the Motor is servo-off.
- The followings shows the parameters which are initialized by execution of command SI.

  SI : Initializes servo related parameters (PG, VG, VI, DBP, ILV, FF, FP, FS, NP, NS, LG, TL, SG, FO, FC)

  SI/AL : Initializes all parameters.

  SI/SY : This parameter initializes all parameters excluding PA for ESA25 type Driver Unit.

  SI/YS : Initializes all parameters. PA will be set to 700.

  * Executing "SI/AL" entails resolver phase adjustment. Be careful that the Motor is not locked by an external force. Do not perform initializing only to the Driver Unit.

  Caution : *It requires approximately 30 seconds to initialize the system. Do not turn off the power while initializing. Otherwise, the memory error will arise.*

  * If the memory is faulty, SI/AL will be executed when SI and SI/SY are input.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

★ *SL : Set Servo Loop*

Format : SL data
Data : 1, 2, 3
Shipping set : 3
Default : Not available

- Sets the control mode.
  SL1 : Torque control mode
  SL2 : Velocity control mode
  SL3 : Position control mode

- Position control mode is valid immediately after inputting this command.

- "TS" or "?SL" command reports the current setting.

★ *SM : Factory use only*

Shipping set : 1

Caution : *"SM" is properly set at the factory. Do not change the setting.*

SP : Start Program

Format : SP data
Data range : 0 ~ 63 or /AJ (Adjust mode)
Default : 0

- Executes the program of a channel specified by "data."

- "SP/AJ" command executes the demonstration program (back and forth operation).

SV : Servo-on

Format : SV

- When the Motor servo is turned off by "MO" command, executing the "SV" command will turn the Motor servo on.

- To turn the Motor servo on by the "SV" command, the SVON input of CN2 must be ON.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

TA : Tell Alarm Status

Format : TA
Data : None /HI/ CL
Default : None

- TA : Reports alarms currently arisen.
- TA/HI : Displays history of alarms. Refer to “14.2.5. History of Alarms.”
- TA/CL : Clears history of alarms. Password is required to execute the command.
- There will be no indication when no alarm is reported.
- Indication below is displayed when the alarm is reported.
- When an alarm is reported, it is identified as shown below.

Alarm	7 segments LED	Terminal Display
Memory error	E0	E0>Memory Error
EEPROM error	E2	E2>EEPROM Error
System error	E7	E7>System Error
Interface error	E8	E8>I/F Error
Analog command error	E9	E9>ADC Error
Excess Position error	F1	F1>Excess Position Error
Software Over Travel Limit	F2	F2>Software Over Travel
Hardware Over Travel Limit	F3	F3>Hardware Over Travel
Emergency Stop	F4	F4>Emergency Stop
Program error	F5	F5>Program Error
Automatic Turing error	F8	F8>AT Error
RS232C error	C2	C2>RS-232C Error
CPU error	C3	C3>CPU Error
Resolver Circuit error	A0	A0>Resolver Circuit Error
Software Thermal Sensor	A3	A3>Overload
Velocity error over	A4	A4>RUN away
Heat Sink Overheat or Regeneration Resistor Overheat	P0	P0>Over Heat
Abnormal Main AC Line Voltage	P1	P1>Main AC Line Trouble
Over Current	P2	P2>Over Current
Control AC Line Under Voltage	P3	P3>Control AC Line Under Voltage

- When multiple alarms are reported, a pause between the alarms will start a new line.
- Switching display format by MM is effective.
- Example of display: Hardware travel limit and emergency stop are displayed by MM1 format.

```
:TA
 F3>Hardware Over Travel;
 F4>Emergency Stop;
:_
```


Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

TC : Tell Channel Program

Format : TC data
Data : 0 ~ 63 or /AL
Default : 0

- Reports the program contents of a channel specified by “data.”
- No data is displayed if program is not set to the channel.
- “TC/AL” command is to scroll all channels by pressing the space key.

TE : Tell Position Error Counter

Format : TE/RP

- Reads out the value of position error counter. The reading shall be between –2 147 483 648 and +2 147 483 647. When it exceeds (or falls below) the upper (or lower) limit, the reading will change to backward counting in minus (or plus) side.
- When only “TE” is entered, the display shows the current reading once.
- If an /RP option is added to a “TE” command, reading is repeated automatically.
- In automatic reading, a value consisting of up to six figures is read out. If a value consists of more than six figures, “********” is displayed.
- To terminate automatic reading, press the BS key.

★ *TL : Torque Limit Rate*

Format : TL data
Data : 0 ~ 100 [%]
Shipping set : 100
Default : 0

- Sets the torque limit.
- The Motor torque will be reduced to a percentage (%) of the value immediately after “TL” is input and the Motor torque is controlled not to exceed the limit thereafter.
- “TS” or “?TL” reads the current setting.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

TP : Tell Position

Format : TP data/RP
Data : 2, 5
Shipping set : None
Default : Not available

- "TP" command reads the current position of the Motor in the position scale set by PS parameter.
- If /RP is executed with an /RP option, reading is repeated automatically.
- If only "TP data" is executed, the display shows the current position once.
- To terminate automatic reading, press the BS key.
- TP2/RP : in the units of pulse
  YS, JS1, JS2, RS : 614 400 pulses/revolution
  SS : 491 250 pulses/revolution
  AS, BS, JS0 : 409 600 pulses/revolution
- TP5/RP : in the units of 0.01°
  36 000/revolution

TR : Tell RDC Position Data

Format : TR/RP

- TR reads data of RDC position data.
- Data is between 0 and 4 095.
- If TR command is executed with /RP option, reading is repeated automatically.
- "TR" command reads out the status at the moment.
- To terminate automatic reading, press the BS key.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

TS : Tell Settings

Format : TS data
Data : 0 ~ 13
Default : 0

- This is to read out parameter settings. The parameter to be read out varries with the data.

1) Standard ESA 25

TS0 : Reads out all parameters listed below.
TS1 : PG, VG, VI, VM, LG, TL
TS2 : FO, FP, FS, NP, NS, DBP, DBA, ILV, FF, FC
TS3 : CO, IN, IS, FW, VO, VW
TS4 : CR, PC, RR
TS5 : FD, FZ, FR
TS6 : PS, DI, OTP, OTM
TS7 : MV, MA, JV, JA, HV, HA, HZ
TS8 : OS, HD, HO
TS9 : PA, OL, RC, LR
TS10 : AB, SM, NW
TS11 : MM, BM, CM, AN, WM, SE
TS12 : LO, SG, MT, RI, ZP, ZV
TS13 : SL, AC, AGV, AGT

- Report format may be selected by MM.

VG : Velocity Gain

Format : VG data
Data : 0.1 ~ 255.0 or /AJ (Adjusting mode)
Shipping set : 1.0
Default : Not available

- Sets velocity loop proportional gain.
- "VG/AJ" command starts the fine adjusting program.
- "TS" or "?VG" reports the current setting.
- When LO and SG data are changed, the gain will be automatically adjusted.
- When VG data is changed, LG and SG data will be cleared to 0.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

VI : Velocity Integrator Frequency

Format : VI data
Data : 0.10 ~ 63.00 [HZ] or /AJ (Adjusting mode)
Shipping set : 1.00
Default : Not available

- Sets the integration frequency of velocity loop.
- "VI/AJ" starts the fine adjusting mode.
- "TS" or "?VI" reports the current setting.
- VI will be automatically adjusted when LO and SG data are chnaged.
- When VI data is changed, LO and SG data is cleared to 0.

★ *VM : Velocity Integrator Mode*

Format : VM data
Data : 0, 1
Shipping set : 1
Default : 0

- Changes the velocity loop integrator control as shown below.
  VM0 : Velocity loop P control.
  VM1 : Velocity loop PI control.

★ *VO : Velocity Error Over Limit*

Format : VO data
Data : 1 ~ 4 095
Shipping set : 1 365
Default : Not omissible

- This is to set the error limit to detect velocity error over alarm.
- Velocity error over alarm will be given when the deviation of velocity exceeds the setting.
- Correspondence between velocity error and data depends on Motor type.

Motor type	Number of teeth (lamination)	Set data
YS, JS1, JS2, RS	150	data = Velocity error limit [s^{-1}] × (4 095/3)
SS	120	data = Velocity error limit [s^{-1}] × (4 095/3.75)
AS, BS, JS0	100	data = Velocity error limit [s^{-1}] × (4 095/4.5)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

★ *VW : Velocity Error Over Limit Width*

Format : VW data
Data : 0 ~ 1 000
Shipping set : 100
Default : 0

- This is to set the time length to detect velocity error over limit.
- When velocity error limit is over for VW (time length), velocity over limit alarm is given.

★ *WD : Write Data to EEPROM*

Format : WD

- Writes all current settings of programs and parameters to EEPROM.
- Use this command when "WM1" (data back-up invalid) is set.

Caution : • Approximately 30 seconds are required to execute this command.

• Do not turn the power off while executing the command.

• Otherwise, memory error alarm may be given.

★ *WM : Write Mode to EEPROM*

Format : WM data
Data : 0 or 1
Shipping set : 0
Default : 0

- 500 000 times of resetting/deleting parameters to EEPROM are possible as data back-up. However, frequent resetting/deleting of parameters may exceed the expected life of EEPROM. "WM" is to select data back-up mode to reduce frequency of parameter resetting/deleting.

  WM0 : Data back-up valid
  WM1 : Data back-up invalid

Caution : • When the setting is changed from "WM1" to "WM0", it takes approximately 30 seconds for storing all data.

• Do not turn the power off while executing the command.

• If the power is turned off, memory error alarm may be given.

Caution : When "SI" is executed, all initialized parameters are stored to EEPROM even "WM" command is set to invalid.

- "TS" or "?WM" reports the current setting.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

★ *ZP : Factory Use Only*

Shipping set : 1.00

Caution : • The parameter is for the automatic tuning function and is set at the factory.

• Do not change the setting.

• "TS" or "?ZP" command reports the current setting.

★ *ZV : Factory Use Only*

Shipping set : 1.4

Caution : • The parameter is for automatic tuning function and to be set at the factory

• Do not change the setting.

• "TS" or "?ZP" command reports the current setting.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

13. Maintenance

13.1. Precautions

- Back up Motor and Driver Unit
  - ◊ We recommend to have a back up Motor and Driver Unit for unexpected shut down of the system.
- Parameter and program back up
  - ◊ For an unexpected shut down of the Driver Unit, all parameters and programs should be recorded.
  - ◊ For your convenience, the list of parameter and program is provided in the last page of this manual.
- How to replace the Driver Unit.
  - ◊ Standard ESA25 Driver Units are interchangeable with each other. It may be replaced simply by inputting same parameter settings of old Driver Unit.
    Following shows reference number of standard ESA25 Driver Unit.
    - M-ESA-*****T25
    - M-ESA-*****V25

    (***** represents Motor number. The Driver Unit to be replaced must have same number.)
- If your Driver Unit is not standard, refer to the specification documents for interchangeability.
- When replacing the Driver Unit, refer to “Appendix 4: How to Replace ESA25 Driver Unit.”
- ESA25 Driver Unit has EEP-ROM and does not need a battery for memory back up.

  (Life of EEP-ROM : approximately 500 000 times of writing on and off.)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

13.2. Maintenance Check

13.2.1. Motor

- Since a Megatorque Motor does not have any parts which will wear out, a daily maintenance check should be enough.

- The table below shows the maintenance check and intervals. The checking interval shown in the table is reference only. It should be decided accordingly to the actual use conditions.

  Caution : *Do not disassemble the Motor and resolver. If disassembling Motor is necessary, contact your local NSK representative.*

Table 13-1 : Motor maintenance check

Item	Checking interval	How to check	Remarks
Vibration/Noise	Daily	• Touching and hearing	• Watch daily changes
Appearance	According to environment	• Wipe off dust/slag • Blow off slag	–
Insulation	Once/year	• Resistance test (Motor coil and ground earth) (Disconnect Driver Unit)	• Resistance ≥ 10MΩ
Full check	According to Motor condition	• Overhaul (NSK)	–

13.2.2. Driver Unit and Cable Set

- As a Driver Unit does not have any contact point and highly reliable semiconductors are used, the daily check is not necessary. Checkings as shown in Table 13-2 are necessary at least once a year.

Table 13-2

Item	Interval	Check point	Remarks
Retighten screws	Once/year	• Terminal block screw. • Connector fixing screw.	–
Cleaning	Once/year	• Remove dust or contaminants inside of Driver Unit.	–
Cable check	Once/year	• Check for damages and cracks of cables.	• When the cable is forced to bend or twist, checking frequency should be increased.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

13.3. Periodical Replacement of Parts

13.3.1. Motor

- There is no parts which is required to be replaced periodically.
- Refer to “13.2. Maintenance Check”.

13.3.2. Driver Unit

- Electrolytic condenser
  - ◊ The gradual chemical change of electrolytic condensers will deteriorate system function and it may result in the system failure.

Table 13-3

Parts	Function	Life	How to replace
Electrolytic condenser	Equalize power voltage	10 years	• Replace *PCB. • Replace whole unit.

*PCB: Printed circuit boad

- Life of electrolytic condenser relies on the operating conditions. The 10 years of life is rough estimation under continuous operation in normal room environment.

13.4. Storing

- Store the Motor and Driver Unit in clean and dry indoor condition.
- A Driver Unit has a lot of ventilation holes and should be covered properly to protect from dust.

Table 13-4

Storing condition		Remarks
Temperature	-20°C ~ +70°C	–
Humidity	20% ~ 80%	No condensation

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

13.5. Warranty Period and Covering Range

13.5.1. Warranty Period

- The warranty period is one year from the date of delivery of the product or 2400 working hours whichever comes first.

13.5.2. Range of Warranty

1) The items to be warranted shall be the supplied products by NSK Ltd.
2) The supplier will repair the supplied products free of charge within the warranty period.
3) The supplied products will be repaired with cost and fees paid by the customer after the warranty period.

13.5.3. Immunities

- The product is not warranted in one of the following cases even within the warranty period:
  1) Failure of the unit due to installation and operation not in accordance with the instruction manual specified by the supplier.
  2) Failure of the unit due to improper handling and use, modification and careless handling by the user.
  3) Failure of the unit due to the causes other than those attributable to the supplier.
  4) Failure of the unit due to modification or repair which is conducted by a person(s) or party(ies) other than the supplier.
  5) Other types of failures due to natural disasters and accidents (causes not attributable to the responsibility of the supplier).
  6) Designated consumables (fuses for ESA25 Driver Unit).
- Damages induced by a failure of the supplied unit are not covererd.

13.5.4. Service Fee

- NSK Ltd. reserves the right to charge to a user for the service such as dispatch of engineer(s).
- Startup, maintenance and adjusting of the unit under the supervision of our engineer(s) is a paid service even if it is to be provided during the warranty period.
- Service fees shall be billed to the customer according to the rules on paid services.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

14. Alarm

14.1. Identifying Alarm

- The DRDY output opens when error occurs in ESA25 Driver Unit.
- 7-segemnt LED is provided on the front panel of the Driver Unit to identify the alarm. “TA” command can be used to identify alarms.

14.1.1. LED Alarm Indicator

Figure 14-1

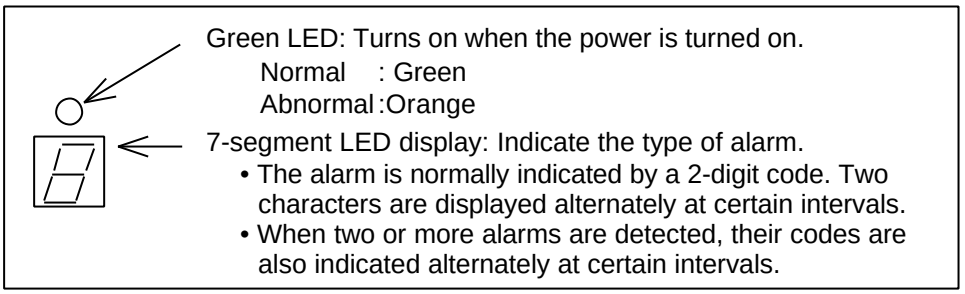
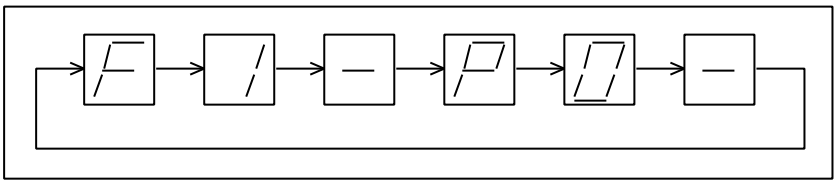
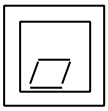

Green LED: Turns on when the power is turned on.
Normal : Green
Abnormal :Orange
7-segment LED display: Indicate the type of alarm.
• The alarm is normally indicated by a 2-digit code. Two characters are displayed alternately at certain intervals.
• When two or more alarms are detected, their codes are also indicated alternately at certain intervals.

Figure 14-2: Abnormal (example)



(Example) Excess position error F1 + Heat Sink Over-Temperature P0

Figure 14-3: The LED is indicating normal state.

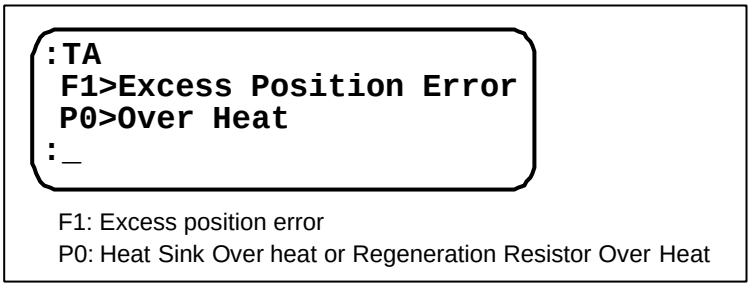


Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

14.1.2. Using TA Command

- "TA" command is to display the alarm code on the Handy Terminal screen.
- In this case, the code is not displayed at different time as the LED display.
  - ◊ Example
    - ◊ Excess position error and heat sink overheat alarms will be displayed as shown in Figure 14-4.

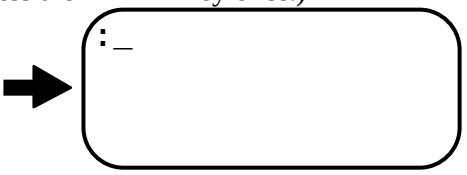
Figure 14-4: Alarm display



[Example 1] Identify alarms as the warning lamp of ALARM is on.

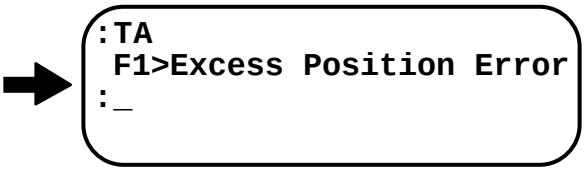
1) Confirm that the display of Handy Terminal shows the colon " : ."

(If the colon " : " is not shown in the display, press the ENTER key once.)



2) Input TA command.

3) Press ENT key to exeute and the display identifies the alarm.



- Thus the alarm is identified as "Excess position error".

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

14.1.3. Alarm Code List

- Reports alarm status.
- No display is shown when any alarm is not issued.
- When an alarm is detected, the display identifies an alarm as shown in the table below.

Table 14-1: Alarm code list

Alarm	7 segments LED	Terminal Display
Memory error	E0	E0>Memory Error
EEPROM error	E2	E2>EEPROM Error
System error	E7	E7>System Error
Interface error	E8	E8>I/F Error
Analog command error	E9	E9>ADC Error
Excess Position error	F1	F1>Excess Position Error
Software Over Travel Limit	F2	F2>Software Over Travel
Hardware Over Travel Limit	F3	F3>Hardware Over Travel
Emergency Stop	F4	F4>Emergency Stop
Program error	F5	F5>Program Error
Automatic Turing error	F8	F8>AT Error
RS232C error	C2	C2>RS-232C Error
CPU error	C3	C3>CPU Error
Resolver Circuit error	A0	A0>Resolver Circuit Error
Software Thermal Sensor	A3	A3>Overload
Velocity error over	A4	A4>RUN away
Heat Sink Overheat or Regeneration Resistor Overheat	P0	P0>Over Heat
Abnormal Main AC Line Voltage	P1	P1>Main AC Line Trouble
Over Current	P2	P2>Over Current
Control AC Line Under Voltage	P3	P3>Control AC Line Under Voltage

- When two or more alarms are detected, each alarm is displayed on a separate line.
- Display mode set by “MM” parameter is valid.
- Display example (Emergency stop and hardware over travel limit alarm are detected in MM1 setting.)

```
:TA
 F3>Hardware Over Travel;
 F4>Emergency Stop;
:_
```


Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

14.2. Description of Alarm

Caution : The DRDY output is normally closed. It opens on abnormal condition.

14.2.1. Normal State

- When the Motor does not operate even in normal state, following causes are suspected.

Table 14-2

Status	Motor condition	DRDY	Cause	Remedy
Power-off	Servo-OFF	open	Power is not supplied.	Turn on power.
CPU Initializing	Servo-OFF	open	Initializing the CPU.	Wait for the CPU to be initialized.
SVON Input OFF	Servo-OFF	close	SVON input is not active.	Activate the SVON input.

14.2.2. Alarms Related to Power Amplifier

14.2.2.1. Heat Sink Overheat or Regeneration Resistor Overheat

[Output] DRDY: Open
[TA] P0 > Over Heat
[LED] P0
[Motor Condition] Servo-OFF

Table 14-3: Cause and Remedy: Overheat of heat sink and regeneration resistor.

Cause	Remedy
(1) Duty cycles of the Motor is too high. (2) Excessive load is applied.	• Reduce the load and/or operation duty. Readjust acceleration/deceleration. (Stop operation, air-cool the Driver Unit.)
(3) Ambient temperature is above 50°C. (4) Heat sink temperature exceeds 90°C due to continued heavy torque demand.	• Check surrounding condition of the Driver Unit. • Stop the operation and air-cool the Motor and Driver Unit. Then check followings. ◊ Whether the duty cycle is too high. ◊ Whether excessive load is applied. ◊ If the ambient temperature of the Driver Unit is too high. • If no troubles are found in the above check and this alarm occurs frequently, contact NSK.
(5) Defective PCB. (As soon as the control power is turned on, the alarm is activated.)	• Replace Driver Unit. ◊ Standard ESA Driver ----------[Appendix 4]

Note : 1) Stop operation immediately.

2) Even the alarm is deactivated, it will be activated again when the thermal sensor is still on.

• Take enough time to air-cool the Motor and the Driver Unit.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

14.2.2.2. Abnormal Main AC Line Voltage

[Output] DRDY: Open
[TA] P1 > Main AC Line Trouble
[LED] P1
[Motor Condition] Servo-OFF

Table 14-4: Cause and Remedy: Abnormal main AC line voltage (Over/Under)

Cause	Remedy
(1) Abnormal power supply voltage. (2) ◊ Main circuit voltage is excessive due to high acceleration/deceleration under heavy load. ◊ Defective power source gives over AC250V to the main power supply for power amplifier main circuit. (3) Defective power source gives under AC70V to power amplifier main circuit.	• Check main power supply. (Excessive voltage, low voltage and power source capacity.) • Check fuse, power source and the cable, then turn power on again.
(4) Blown fuse. (Motor over temperature, abnormal power supply wiring, Driver Unit abnormal.)	• Check blown fuse. • Check the fuse, power supply and cables, then turn on power again.
(5) Excessive regeneration voltage.	• Readjust operation duty, the load and acceleration/deceleration.
(6) Defective PCB. (When the alarm is on after the Motor stops even power source and fuse are normal.)	• Replace Driver Unit. ◊ Standard ESA Driver ---------- [Appendix 4]

Note : 1) When the regeneration dump resistor cannot process regenerative current, the voltage of direct current to main circuit will be too high and the alarm will be on.

2) Decrease acceleration/deceleration.

14.2.2.3. Over Current

[Output] DRDY: Open
[TA] P2 > Over Current
[LED] P2
[Motor Condition] Servo-OFF

Table 14-5: Cause and Remedy: Over current

Cause	Remedy
(1) Poor insulation of the Motor. (Refer to “Appendix 2. How to Check Motor Condition.”)	• Replace Motor.
(2) Defective Motor Cable. (Refer to “Appendix 2. How to Check Motor Condition.”)	• Replace Cable.
(3) Defective FET of Power Amplifier. (When the alarm is on even the Motor and Motor cable are normal.)	• Replace Driver Unit. ◊ Standard ESA Driver ----------[Appendix 4]

Note : The alarm may be accompanied with abnormal main AC line voltage (blown fuse) alarm due to excessive current flow.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

14.2.2.4. Control AC Line Under-Voltage

[Output] DRDY: Open
[TA] P3 > Control AC Line Under Voltage
[LED] P3
[Motor Condition] Servo-OFF

Table 14-6: Cause and Remedy: Control AC line under-voltage

Cause	Remedy
(1) Low voltage of control power input.	• Check control power voltage. (Low voltage due to over current or output shorting.)
(2) Control circuit voltage for the power amplifier falls below 70V due to faulty power supply.	• Turn off power, check the power supply and power cable, then turn on power again.
(3) Faulty PCB. (When the alarm is on after control power is turned on.)	• Replace Driver Unit. ◊ Standard ESA Driver ----------[Appendix 4]

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

14.2.3. Alarms Related to Motor

14.2.3.1. Resolver Circuit Error

[Output] DRDY: Open
[TA] A0 > Resolver Circuit Error
[LED] A0
[Motor Condition] Servo-OFF

Table 14-7: Cause and Remedy: Resolver circuit error

Cause	Remedy
(1) Resolver cable disconnected. (Refer to "Appendix 2. How to Check Motor Condition.")	• Turn off power, check the resolver cable and connector.
(2) Breakage of resolver cable. (Refer to "Appendix 2. How to Check Motor Condition.")	• Replace resolver cable.
(3) Faulty resolver. (Refer to "Appendix 2. How to Check Motor Condition.")	• Replace Motor.
(4) Faulty PCB. (When the alarm is on even the resolver and the cable are normal and the connector is properly secured.)	• Replace Driver Unit. ◊ Standard ESA Driver ----------[Appendix 4]

Note : 1) Check the resolver cable for disconnection and short of wires.

2) Check the connector for contact failure.

3) When the resolver Cable is forced to bend repeatedly, the bending radius and frequency will affect on the life of the cable. It is necessary to check a insulation and continuity of the cable periodically.

4) When an excessive current applied to the resolver, which is induced by internal contact or collision of Motor (rotor and stator), the fuse protecting the exciting circuit of resolver may blow out. Replace of Motor and Driver Unit is required in such a case.

14.2.3.2. Software Thermal Sensor

[Output] DRDY: Open
[TA] A3 > Overload
[LED] A3
[Motor Condition] Servo-OFF

Table 14-8: Cause and Remedy: Overload

Cause	Remedy
(1) Excessive Motor duty cycle.	• Reduce duty cycle and the load. Re-adjust acceleration/deceleration. • The Motor is overheated and air-cooling is necessary after the Motor stops. Then turn on power. (After stopping operation, keep control power on.)
(2) Mechanical restraint to the Motor such as brake or an obstacle.	• Remove mechanical restraint.
(3) Improper gain setting.	• Readjust gain. (Refer to "8. Tuning and Trial Running.")
(4) Unmatched combination of Motor and Driver Unit.	• Check the combination. (Reference number of Motor and Driver Unit.)

Note : Do not change a parameter "OL" setting. It is properly set before shipment.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

14.2.3.3. Velocity Error Over

[Output] DRDY: Open
[TA] A4> Run away
[LED] A4
[Motor Condition] Servo OFF

Table 14-9: Cause and remedy: Run away

Cause	Remedy
(1) Velocity of Motor has reached to the limit due to external disturbance.	Clear the alarm.
(2) Velocity of Motor has reached to the limit due to overshooting.	• Reduce setting of acceleration rate. • Reduce rotational speed.
(3) Motor tends to vibrate due to poor servo tuning.	Tune Motor properly.
(4) Motor runs away. (out-of-control)	• Confirm the PA data for abnormality. • Replace Driver Unit. ◊ Standard ESA Driver----------[Appendix 4]

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

14.2.4. Alarms Related to Control

14.2.4.1. Memory Error

[Output] DRDY: Open
[TA] E0 > Memory Error
[LED] E0
[Motion Condition] Servo-OFF

Table 14-10: Cause and Remedy: Memory error

Cause	Remedy
(1) Parameters stored in the memory have been rewritten by noise or other cause.	• Initialize the memory then reenter the parameters. (Refer to "12. Command and Parameter.")
(2) Faulty PCB. (When the memory is not functioning after initialized.)	• Replace Driver Unit. ◊ Standard ESA Driver ----------[Appendix 4]

◊ Command "SI" (RS-232C communication) initializes the memory. After initializing, some parameters are reset to shipping set. Resetting parameters to actual use condition are necessary.

14.2.4.2. EEPROM Error

[Output] DRDY: Open
[TA] E2 > EEPROM Error
[LED] E2
[Motor Condition] Servo-OFF

Table 14-11: Cause and Remedy: EEPROM error

Cause	Remedy
(1) Faulty EEPROM of control circuit.	• Turn the power on again. • Replace Driver Unit. ◊ Standard ESA Driver ----------[Appendix 4]

14.2.4.3. System Error

[Output] DRDY: Open
[TA] E7>System Error
[LED] E7
[Motor Condition] Servo-OFF

Table 14-12: Cause and Remedy: System Error

Cause	Remedy
(1) Faulty ROM on PCB. (2) Faulty EEPROM on PVB.	• Replace Driver Unit. ◊ Standard ESA Driver ----------[Appendix 4]

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

14.2.4.4. CPU Error

[Output] DRDY: Open
[TA] Disabled
[LED] Unstable
[Motor Condition] Servo-OFF

Table 14-13: Cause and Remedy: CPU error

Cause	Remedy
(1) CPU is out of control due to noise.	• Turn power on again. • The alarm is deactivated when the power is turned on again. If the alarm occurs frequently, contact NSK.
(2) Faulty PCB. (When the alarm is not deactivated after the power is turned on.)	• Replace Driver Unit. ◊ Standard ESA Driver ----------[Appendix 4]

Note : 1) RS-232C communication and other controls are disabled because CPU is not functioning.

2) Contact NSK if the alarm occurred.

14.2.4.5. Interface Error

[Output] DRDY: Open
[TA] E8 > I/F Error
[LED] E8
[Motor Condition] Servo-OFF

Table 14-14: Cause and Remedy: Interface error

Cause	Remedy
(1) Defective I/O Board in Driver Unit	• Replace Driver Unit. ◊ Standard ESA Driver ----------[Appendix 4]

14.2.4.6. Analog Command Error

[Output] DRDY: Open
[TA] E9 > ADC Error
[Motor Condition] Servo-OFF

Table 14-15: Cause and Remedy: Analog command error

Cause	Remedy
(1) Defective circuit of analog command input	• Replace Driver Unit. ◊ Standard ESA Driver ----------[Appendix 4]

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

14.2.4.7. Excess Position Error

[Output] DRDY: Open
[TA] F1 > Excess Position Error
[LED] F1
[Motor Condition] Servo Lock

Table 14-16: Cause and Remedy: Excess position error

Cause	Remedy
(1) Position error counter value is over "CO" setting due to mechanical restraint such as brake.	• Remove mechanical restraint.
(2) Improper gain setting.	• Readjust gain. (Refer to "8. Tuning and Trial Running.")
(3) Excessive acceleration/deceleration.	• Decrease acceleration/deceleration.
(4) "CO" setting is too low.	• Increase "CO" setting. • Activate the "CLR" input to cancel alarm, then position error counter is cleared to 0 (Zero). • Adjust servo parameters (VG, VI, PG). • Adjust acceleration/deceleration (MA). • Check the applied load.
(5) Unmatched combination of Motor and Driver Unit.	• Check reference number of Motor and Driver Unit.
(6) Improper "PA" setting.	• Set "PA" to 700.
(7) Faulty PCB. (When the alarm is on even "RUN" command is not executed.)	• Replace Driver Unit. ◊ Standard ESA Driver ----------[Appendix 4]

14.2.4.8. Software Over Travel Limit

[Output] DRDY: Open
[TA] F2 > Software Over Travel
[LED] F2
[Motor Condition] Servo Lock in one direction.
(The Motor will only rotate in a direction opposite to that of the rotation limit.)

Table 14-17: Cause and Remedy: Software over travel

Cause	Remedy
(1) The Motor enters the off-limit area set by OTP and OTM	• Put back Motor position in software over travel limit. • Get out of off-limit area.

Note : If the Motor cannot make a full turn due to obstacle or off-limits area, "OTM and OTP" must be set to the point where the Motor can stop before entering off-limit area.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

14.2.4.9. Hardware Over Travel Limit

[Output] DRDY: Open
[TA] F3 > Hardware Over Travel
[LED] F3
[Motor Condition] Servo Lock in one direction.
(The Motor will only rotate in the direction opposite to that of the rotation limit.)

Table 14-18: Cause and Remedy: Software over travel

Cause	Remedy
(1) Motor activated travel limit switch.	• Put back Motor position out of the range of hardware over travel limit.
(2) Mistaken setting of input port polarity.	• Confirm the parameter “AB.”
(3) Faulty travel limit switch or wiring.	• Check the limit switch and wiring.

14.2.4.10. Emergency Stop

[Output] DRDY: Closed
[TA] F4 > Emergency Stop
[LED] F4
[Motor Condition] Servo Lock

Table 14-19: Cause and Remedy: Emergency stop

Cause	Remedy
(1) Mistaken setting of input port polarity.	• Confirm the parameter “AB.”
(2) EMST is input. (A contact)	• Clear EMST input after the Motor stops.
(3) EMST is OFF. (B contact)	• Input EMST ON after the Motor stops.
(4) Faulty wiring.	• Check wiring.

14.2.4.11. Program Error

[Output] DRDY: Closed
[TA] F5 > Program Error
[LED] F5
[Motor Condition] Servo Lock

Table 14-20: Cause and Remedy: Program error

Cause	Remedy
(1) A non-programmed channel is started.	• Check the program. • Check wiring of PRG0~PRG5 input. • Confirm sequence.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

14.2.4.12. Automatic Tuning Error

[Output] DRDY: Closed
[TA] F8 > AT Error
[LED] F8
[Motor Condition] Normal Servo State

Table 14-21: Cause and Remedy: Automatic tuning error

Cause	Remedy	Terminal display
(1) System is in Servo-OFF when executing automatic tuning. (2) EMST or Over Travel Limit is input when executing automatic tuning.	• Check input signal and execute automatic tuning again.	AT Error 1
(3) Automatic tuning cannot be executed due to unbalanced load.	• Check the load condition. • Set parameters manually.	AT Error 2
(4) Automatic tuning cannot be executed due to excessive load.	• Check the load or the mounting base. Increase rigidity.	AT Error 3
(5) Resonant vibration occurs due to low rigidity of the load or the mounting base.	• Set parameters manually.	AT Error 4

14.2.4.13. RS-232C Error

◆ **When parameter is SE "0,"**

[Output] DRDY: Close
[TA] C2>RS232C Error
[LED] C2
[Motor condition] Normal

◆ **When parameter is SE "1,"**

[output] DRDY: Open
[TA] C2>RS232C Error
[LED] C2
[Motor condition] Servo lock

Table 14-22: Cause and remedy: RS-232C error

Cause	Remedy
(1) Connect or disconnect the communication cable with power on.	• Connect or disconnect the communication cable when the power is off.
(2) Attempted to transmit large volume of data without the flow control by CTS or RTS command.	• Wire CTS and RTS signal and apply the flow control.
(3) Wrong Baud rate is set to the terminal.	• Set Baud rate to 9 600 bps.
(4) Defective RS-232C communication.	• Replace Driver Unit. ◊ Standard ESA Driver----------[Appendix 4]

Note : 1) Parameter SE can set DRDY output and condition of Motor servo when RS-232C communication is abnormal. Refer to "12. Command and Parameter."

2) RS-232C error may be cleared by input of CLR or CL command.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

14.2.4.14. CPU Error

[Output] DRDY: Open
[TA] C3>CPU Error
[LED] C3
[Motor condition] Servo-OFF

Table 14-23: Cause and remedy: CPU error

Cause	Remedy
(1) A wrong program is called due to noise.	• Apply the remedy for noise.
(2) Memory is defective.	• Change Driver Unit. • Replace Driver Unit. ◊ Standard ESA Driver ----------[Appendix 4]
(3) CPU is defective.	

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

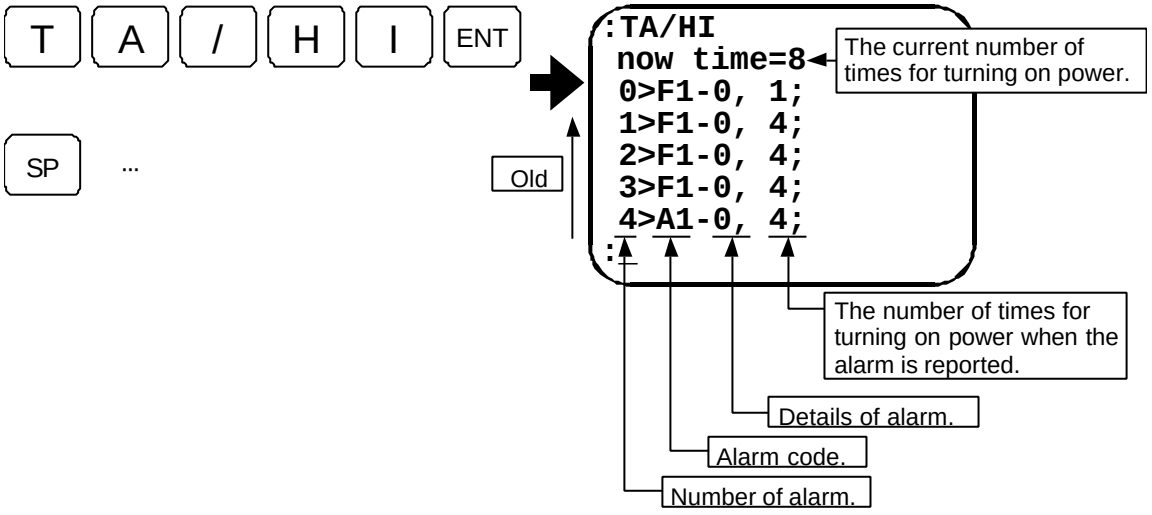
14.2.5. History of Alarm

- Store the occurrence of alarms to EEPROM.
- It keeps the record of alarms up to 32nd before.
- It does not overwrite more than 32nd alarm. Clear the alarm history to keep the record for new alarms.
- This history records the alarm which makes the DRDY output open.
- Contents of record are as follow.
  - (i) Alarm code that is shown on LED.
  - (ii) Details of alarm for failure analysis of the manufacturer.
  - (iii) The number of times the power is turned on.

Caution : History of alarm may not be stored properly when the power is shut off right after the alarm is reported.

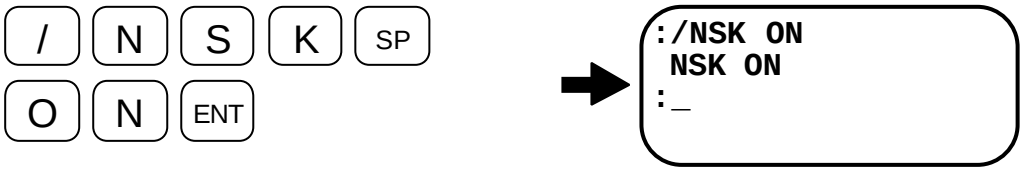
14.2.5.1. Indication of History of Alarm

(1) Input TA command. Press SP key to scroll next line.

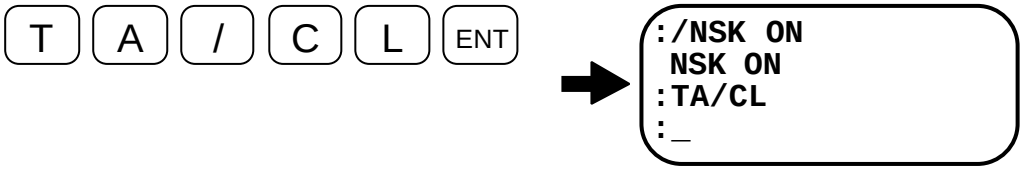


14.2.5.2. Clear History of Alarm

(1) Input password.



(2) Input TA command.



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

(Blank Page)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

15. Troubleshooting

15.1. Identifying Problem

- If problems do occur, check the items shown in Table 15-1.
- When reporting problems to the manufacturer, explanation of the items in Table 15-1 will help to identify the problem.

Table 15-1

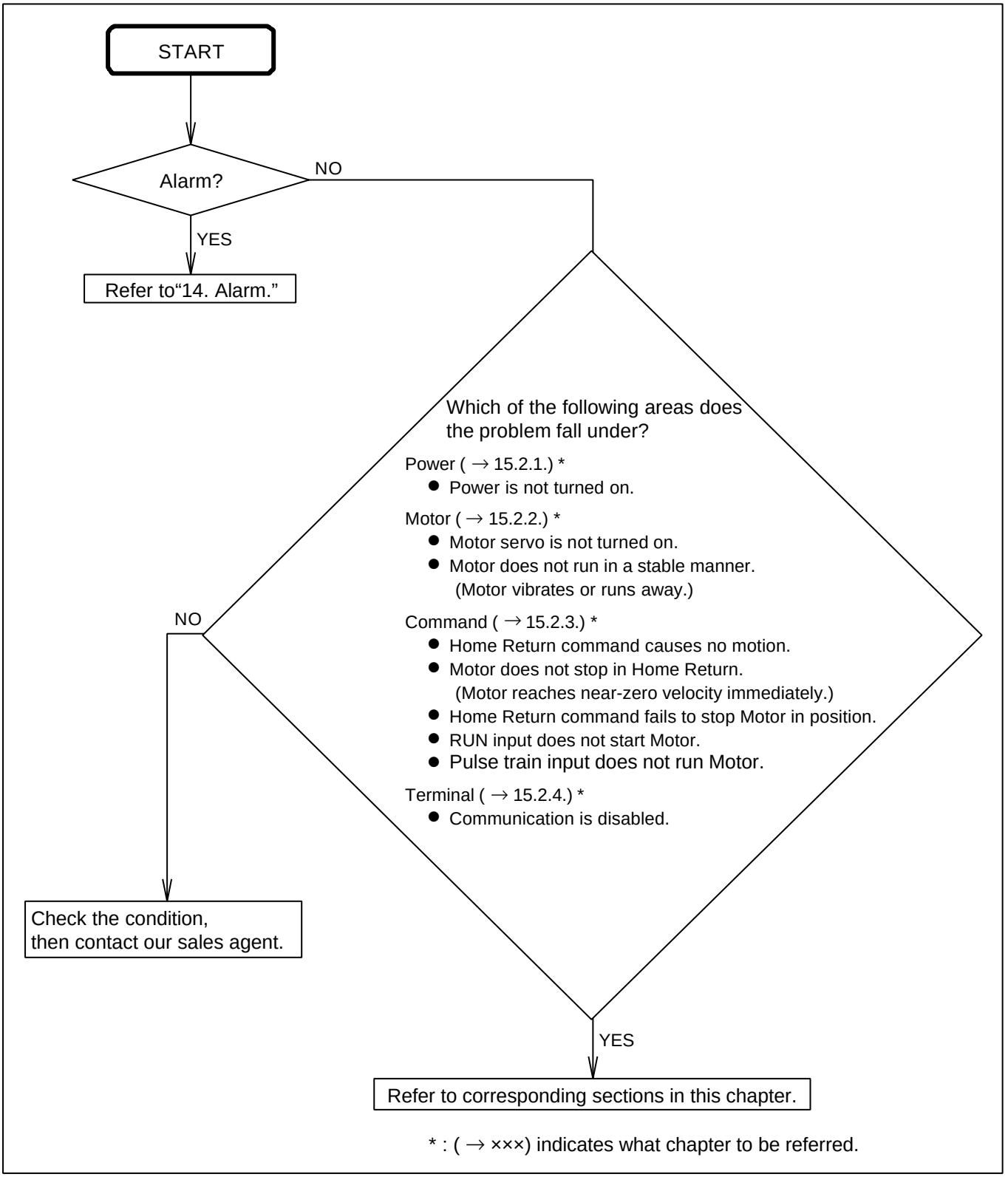
	Items	Point to be checked
1	Combination of Motor and Driver Unit	• Check if the Motor series code, Motor size number and the Maximum torque conform to the indication of the nameplates of the Motor and the Driver Unit. Refer to “6.2. Combination of Motor and Driver Unit” for details.
2	Power supply voltage	• Voltage variation of power source is in specification.
3	Trouble recurrence	• Frequency
4	Occurrence in special occasion	• When a particular command is executed. • A particular equipment is in operation.
5	Occurrence under a particular operation	• Same position/direction • Accelerating/decelerating
6	Alarm Code	• Check alarm code by TA command. (Refer to “14.1.2. Using TA Command.”)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

15.2. Troubleshooting

- When troubleshooting, refer to the flow chart shown below.

Figure 15-1 : Troubleshooting flow

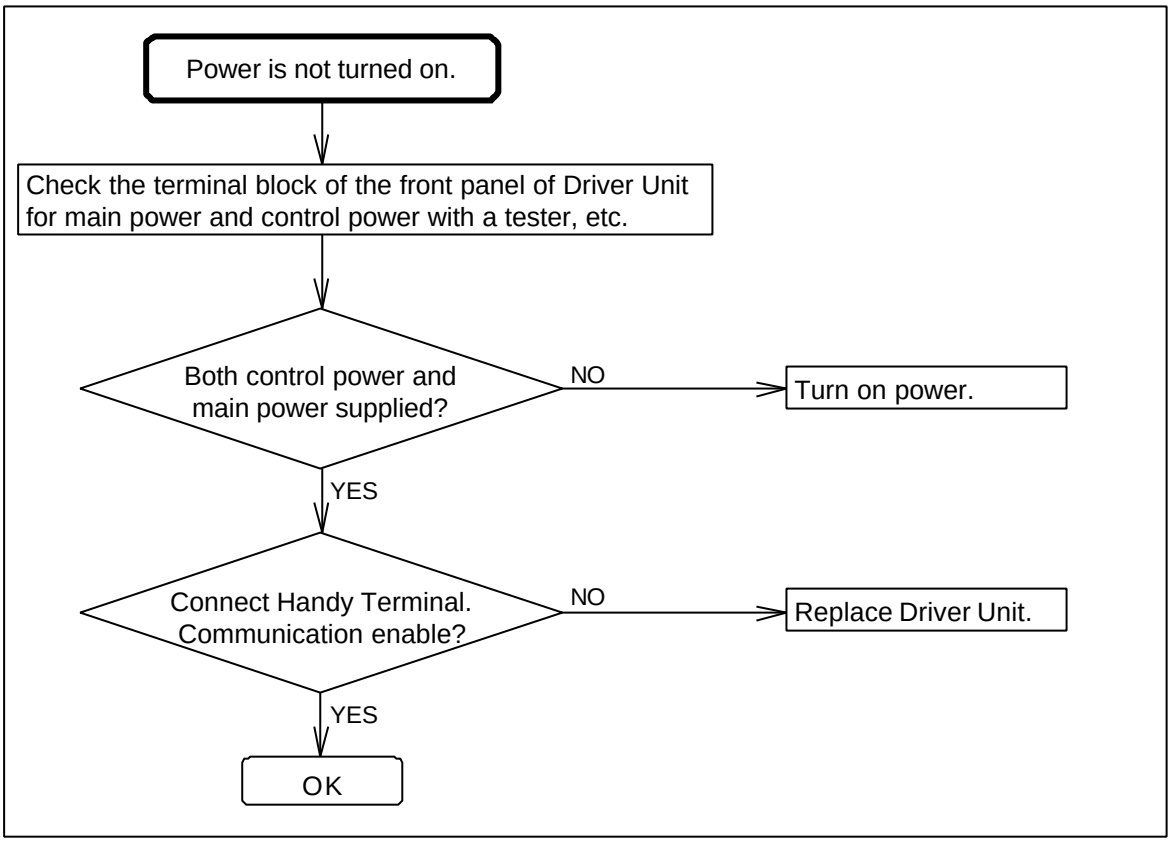

START
Alarm?
NO
YES
Refer to“14. Alarm.”
Which of the following areas does the problem fall under?
Power (→ 15.2.1.) *
Power is not turned on.
Motor (→ 15.2.2.) *
Motor servo is not turned on.
Motor does not run in a stable manner. (Motor vibrates or runs away.)
Command (→ 15.2.3.) *
Home Return command causes no motion.
Motor does not stop in Home Return. (Motor reaches near-zero velocity immediately.)
Home Return command fails to stop Motor in position.
RUN input does not start Motor.
Pulse train input does not run Motor.
Terminal (→ 15.2.4.) *
Communication is disabled.
NO
Check the condition, then contact our sales agent.
YES
Refer to corresponding sections in this chapter.
* : (→ ×××) indicates what chapter to be referred.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

15.2.1. Power Trouble

Power is not turned on.

Figure 15-2 : Power trouble

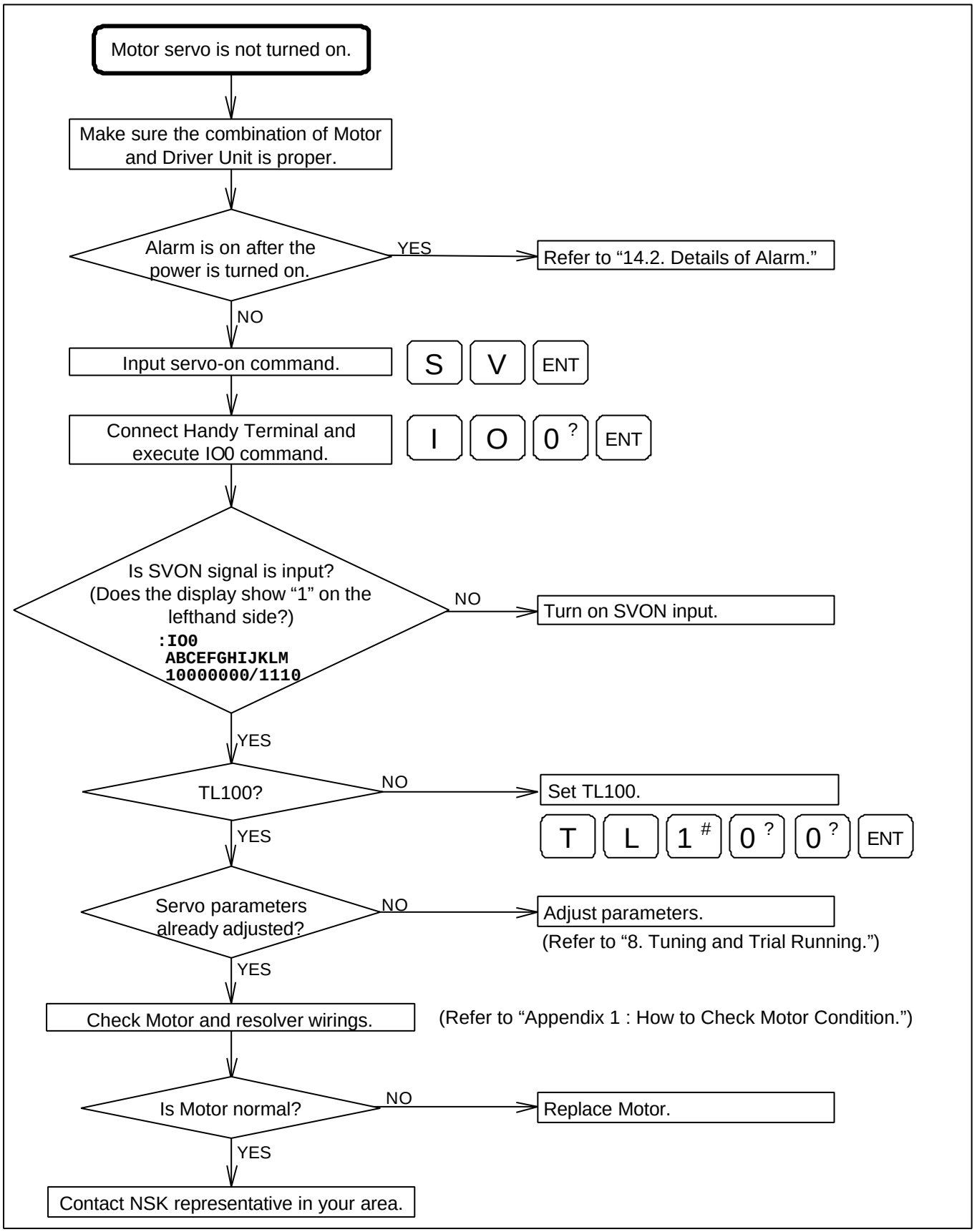

Power is not turned on.
Check the terminal block of the front panel of Driver Unit for main power and control power with a tester, etc.
Both control power and main power supplied?
NO
Turn on power.
YES
Connect Handy Terminal. Communication enable?
NO
Replace Driver Unit.
YES
OK

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

15.2.2. Motor Trouble

1 Motor servo is not turned on.

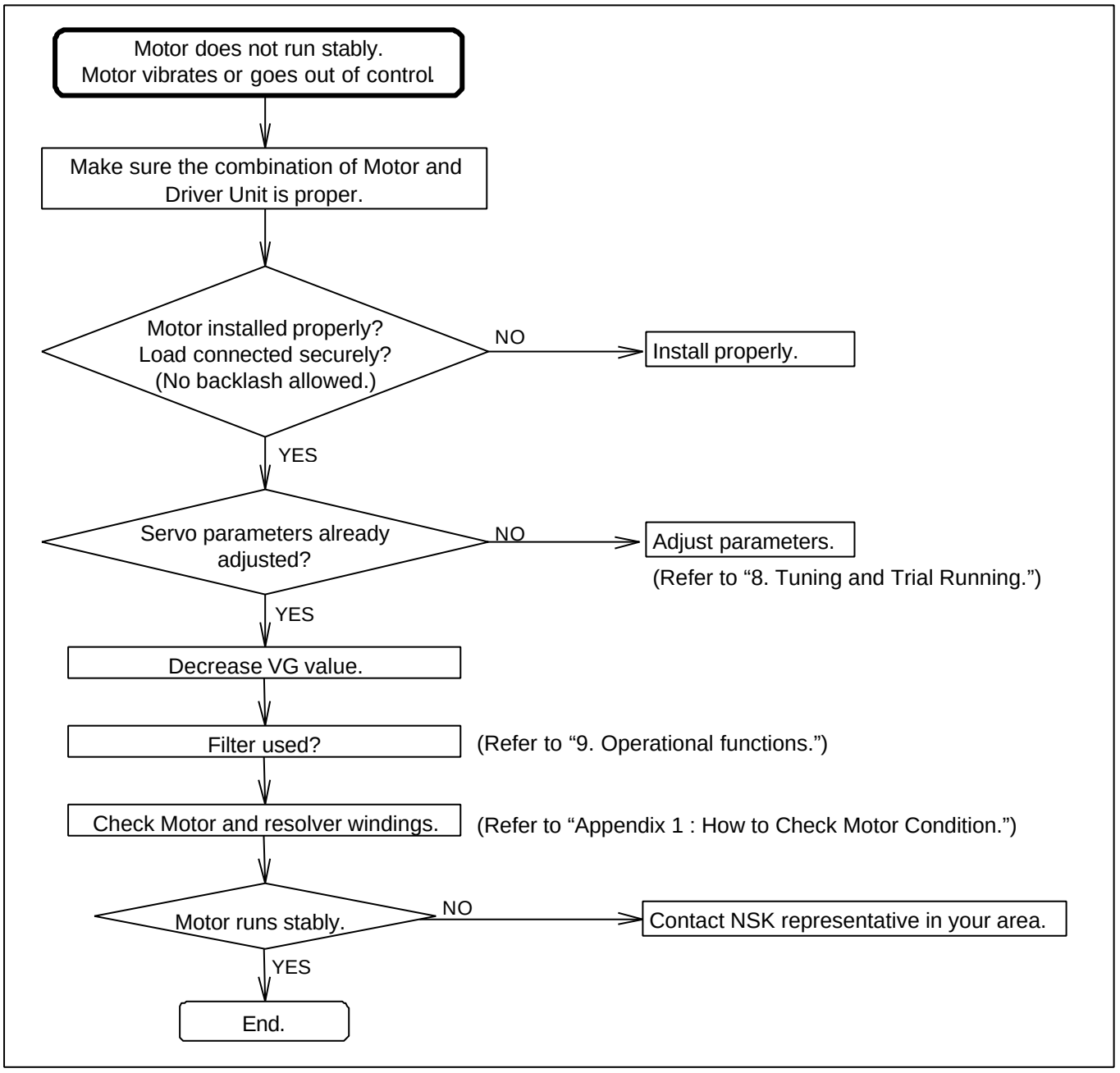
Figure 15-3 : Motor trouble 1



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

2 Motor does not run stably. / Motor vibrates or goes out of control.

Figure 15-4 : Motor trouble 2

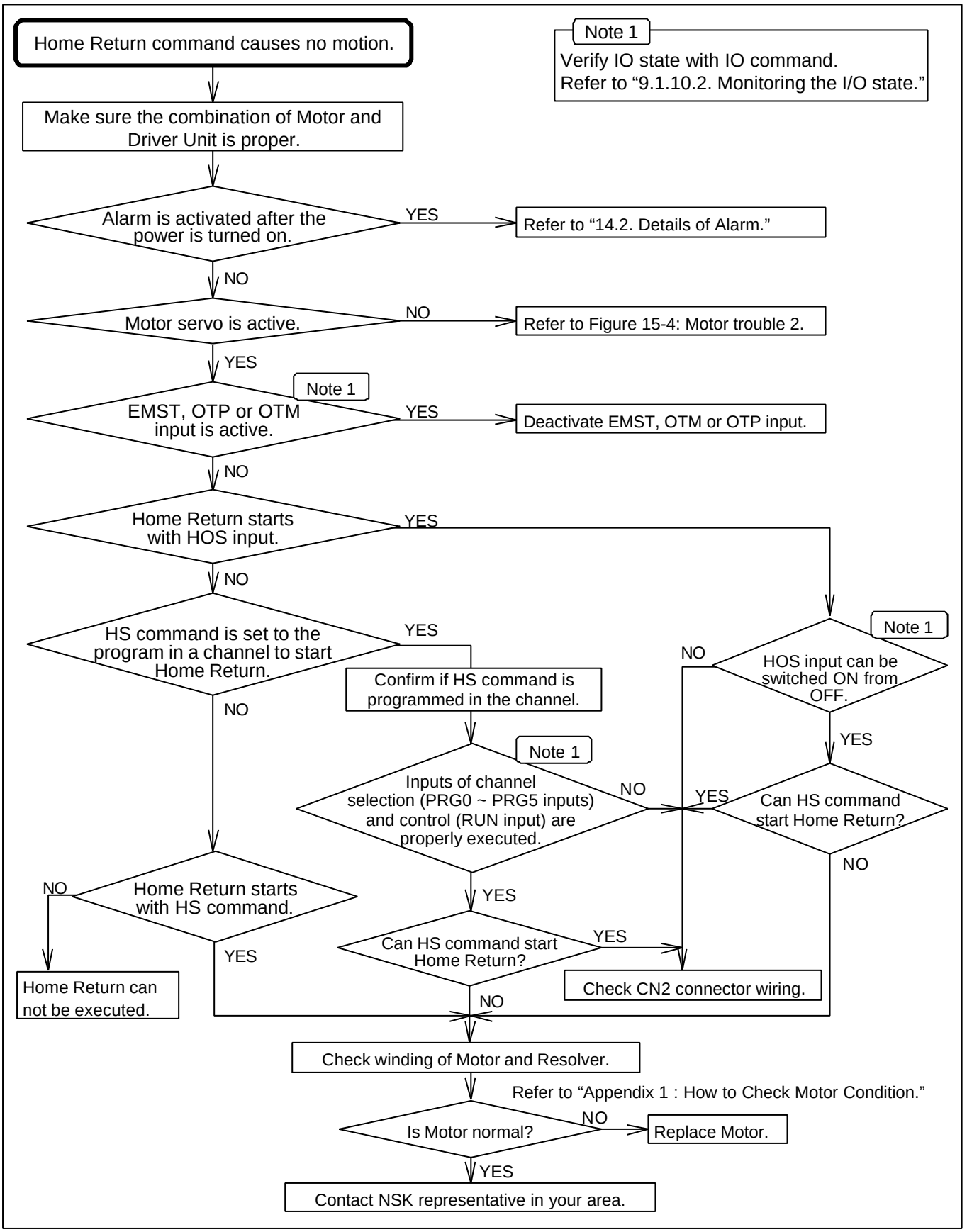


Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

15.2.3. Command Trouble

1 Home Return command causes no motion

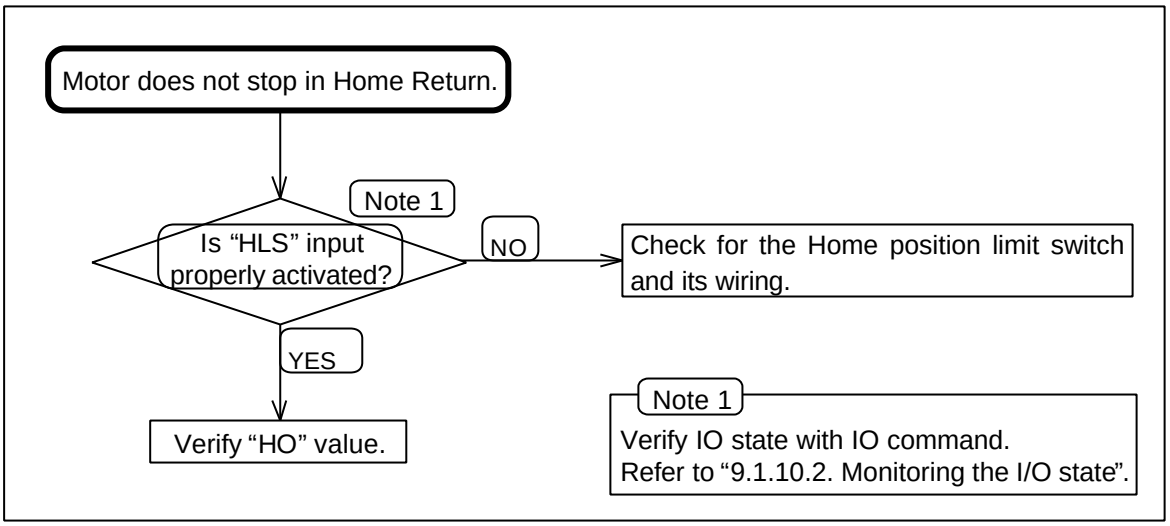
Figure 15-5 : Command trouble 1


Home Return command causes no motion.
Note 1
Verify IO state with IO command.
Refer to “9.1.10.2. Monitoring the I/O state.”
Make sure the combination of Motor and Driver Unit is proper.
Alarm is activated after the power is turned on.
YES
Refer to “14.2. Details of Alarm.”
NO
Motor servo is active.
NO
Refer to Figure 15-4: Motor trouble 2.
YES
Note 1
EMST, OTP or OTM input is active.
YES
Deactivate EMST, OTM or OTP input.
NO
Home Return starts with HOS input.
YES
NO
HS command is set to the program in a channel to start Home Return.
YES
Confirm if HS command is programmed in the channel.
NO
Note 1
Inputs of channel selection (PRG0 ~ PRG5 inputs) and control (RUN input) are properly executed.
NO
YES
Note 1
HOS input can be switched ON from OFF.
NO
YES
Can HS command start Home Return?
NO
NO
Home Return starts with HS command.
YES
Home Return can not be executed.
YES
Can HS command start Home Return?
YES
Check CN2 connector wiring.
NO
Check winding of Motor and Resolver.
Refer to “Appendix 1 : How to Check Motor Condition.”
Is Motor normal?
NO
Replace Motor.
YES
Contact NSK representative in your area.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

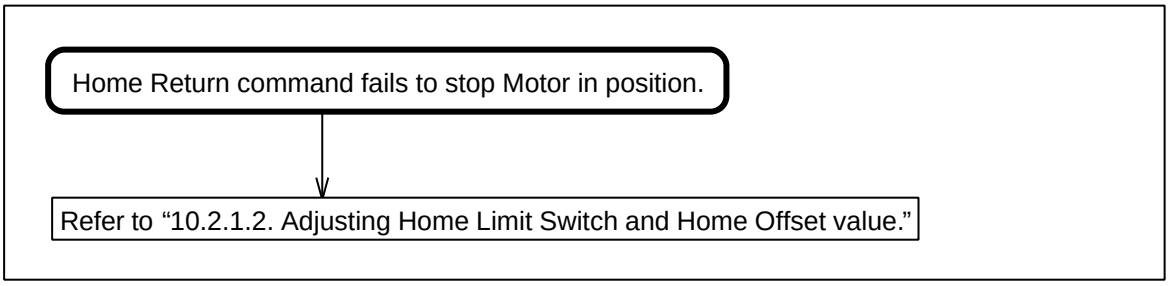
2 Motor does not stop in Home Return.

Figure 15-6 : Command trouble 2


Motor does not stop in Home Return.
Note 1
Is “HLS” input properly activated?
NO
Check for the Home position limit switch and its wiring.
YES
Verify “HO” value.
Note 1
Verify IO state with IO command.
Refer to “9.1.10.2. Monitoring the I/O state”.

3 Home Return command fails to stop Motor in position.

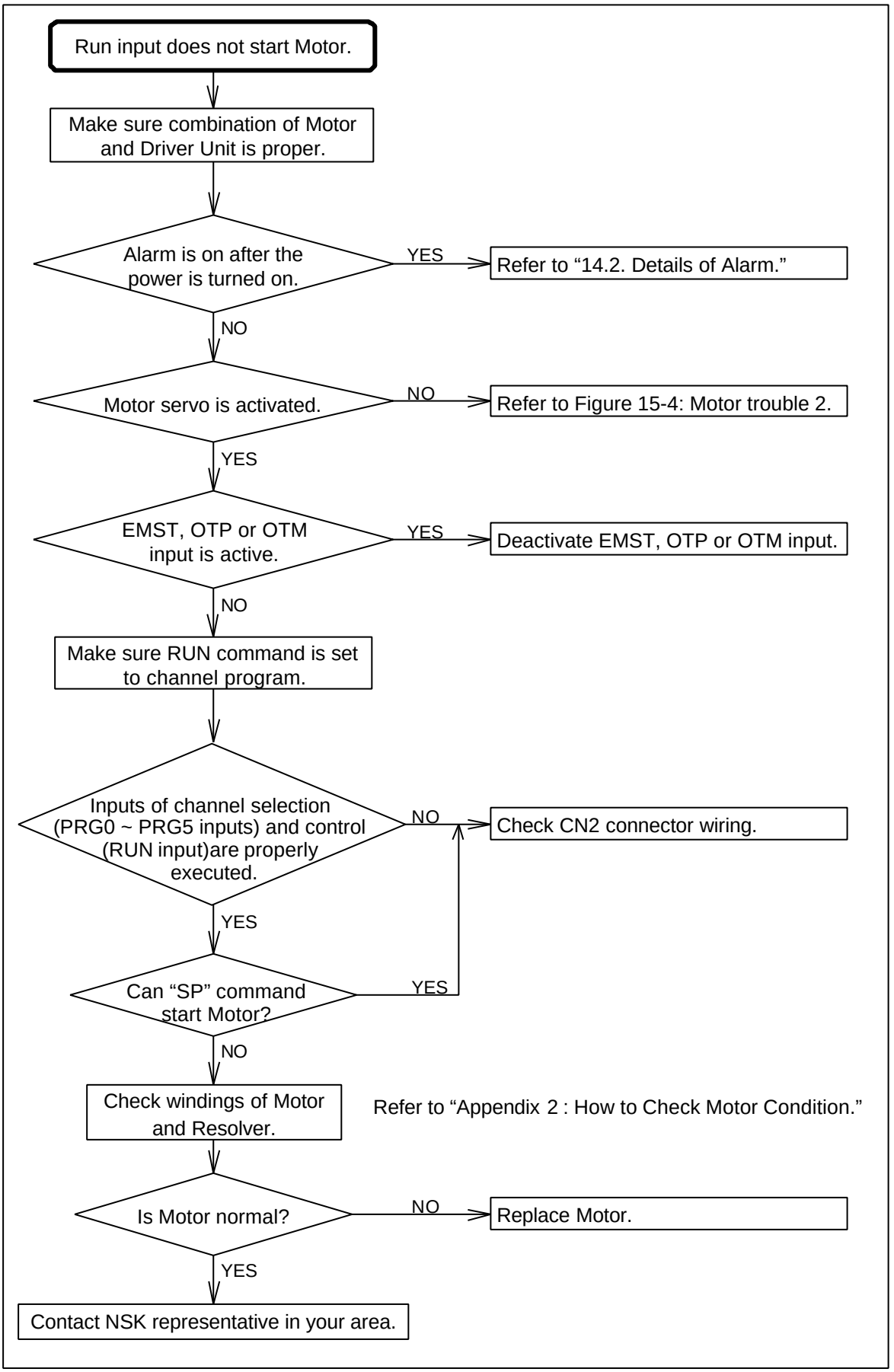
Figure 15-7 : Command trouble 3



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

4 Run input does not start Motor.

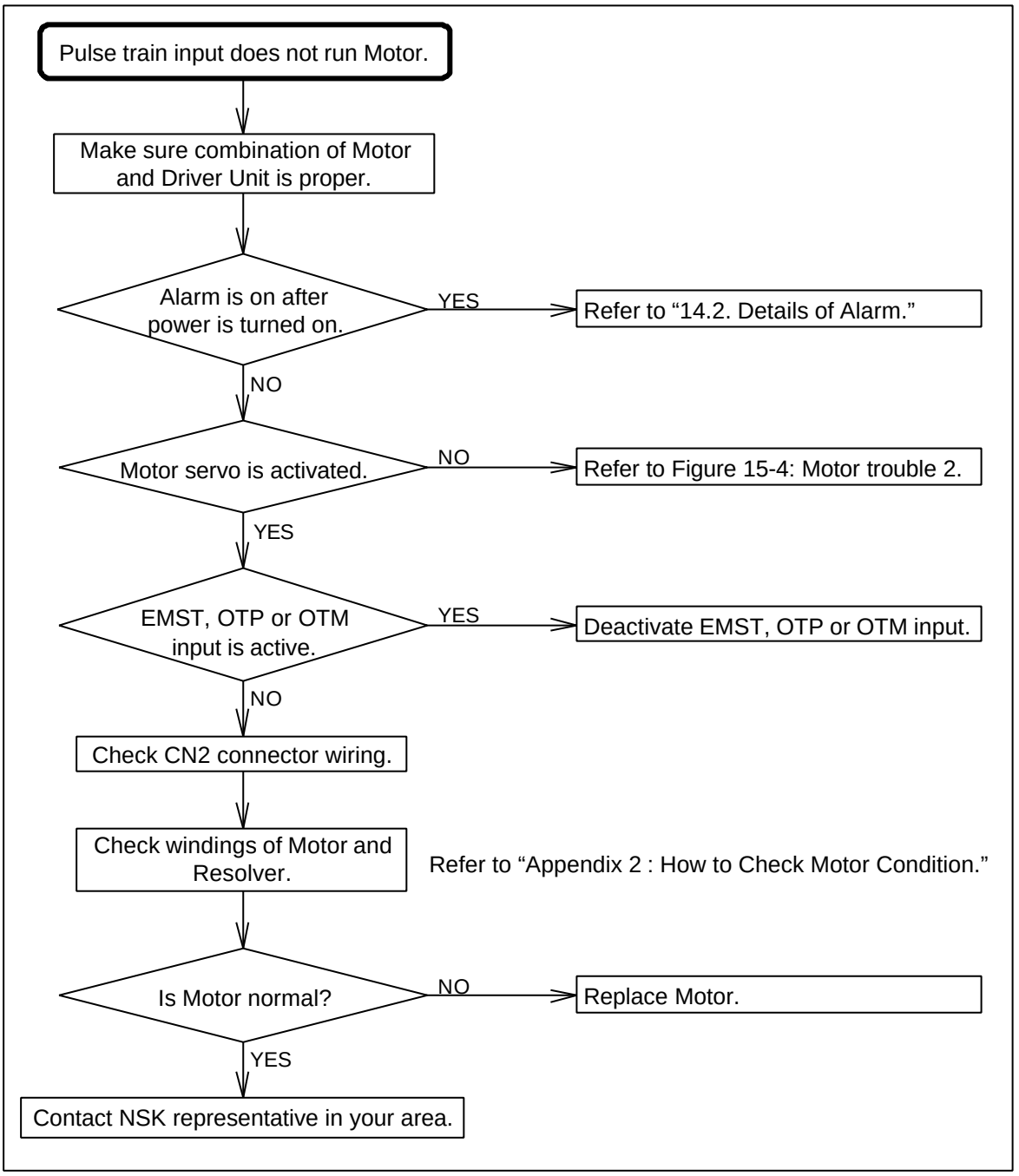
Figure 15-8 : Command trouble 4


Run input does not start Motor.
Make sure combination of Motor and Driver Unit is proper.
Alarm is on after the power is turned on.
YES
Refer to “14.2. Details of Alarm.”
NO
Motor servo is activated.
NO
Refer to Figure 15-4: Motor trouble 2.
YES
EMST, OTP or OTM input is active.
YES
Deactivate EMST, OTP or OTM input.
NO
Make sure RUN command is set to channel program.
Inputs of channel selection (PRG0 ~ PRG5 inputs) and control (RUN input)are properly executed.
NO
Check CN2 connector wiring.
YES
Can “SP” command start Motor?
YES
NO
Check windings of Motor and Resolver.
Refer to “Appendix 2 : How to Check Motor Condition.”
Is Motor normal?
NO
Replace Motor.
YES
Contact NSK representative in your area.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

5 Pulse train input does not run Motor.

Figure 15-9 : Command trouble 5

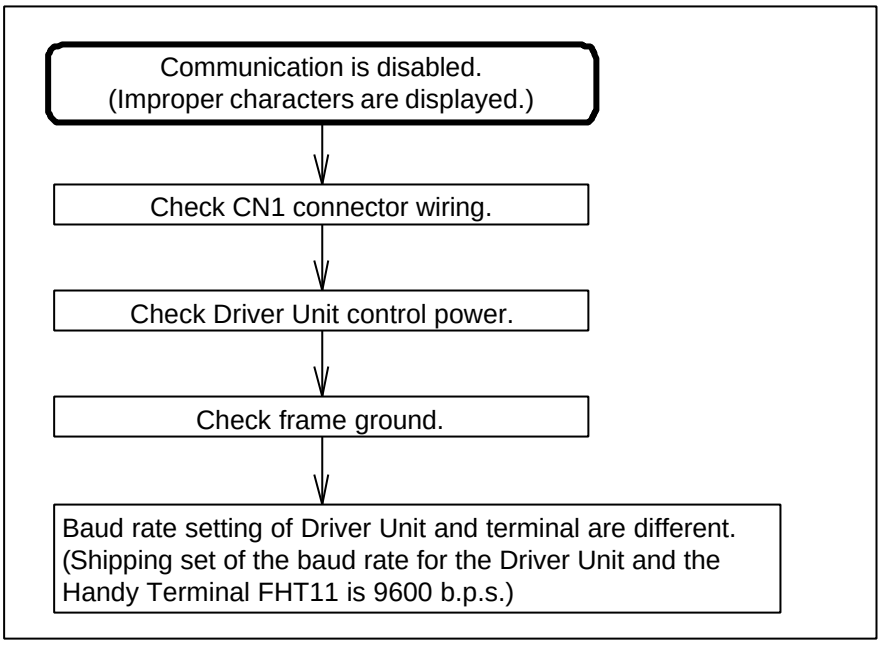

Pulse train input does not run Motor.
Make sure combination of Motor and Driver Unit is proper.
Alarm is on after power is turned on.
YES
Refer to “14.2. Details of Alarm.”
NO
Motor servo is activated.
NO
Refer to Figure 15-4: Motor trouble 2.
YES
EMST, OTP or OTM input is active.
YES
Deactivate EMST, OTP or OTM input.
NO
Check CN2 connector wiring.
Check windings of Motor and Resolver.
Refer to “Appendix 2 : How to Check Motor Condition.”
Is Motor normal?
NO
Replace Motor.
YES
Contact NSK representative in your area.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

15.2.4. Terminal Trouble

Communication is disabled.

Figure 15-10 : Terminal trouble


Communication is disabled.
(Improper characters are displayed.)
Check CN1 connector wiring.
Check Driver Unit control power.
Check frame ground.
Baud rate setting of Driver Unit and terminal are different.
(Shipping set of the baud rate for the Driver Unit and the Handy Terminal FHT11 is 9600 b.p.s.)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

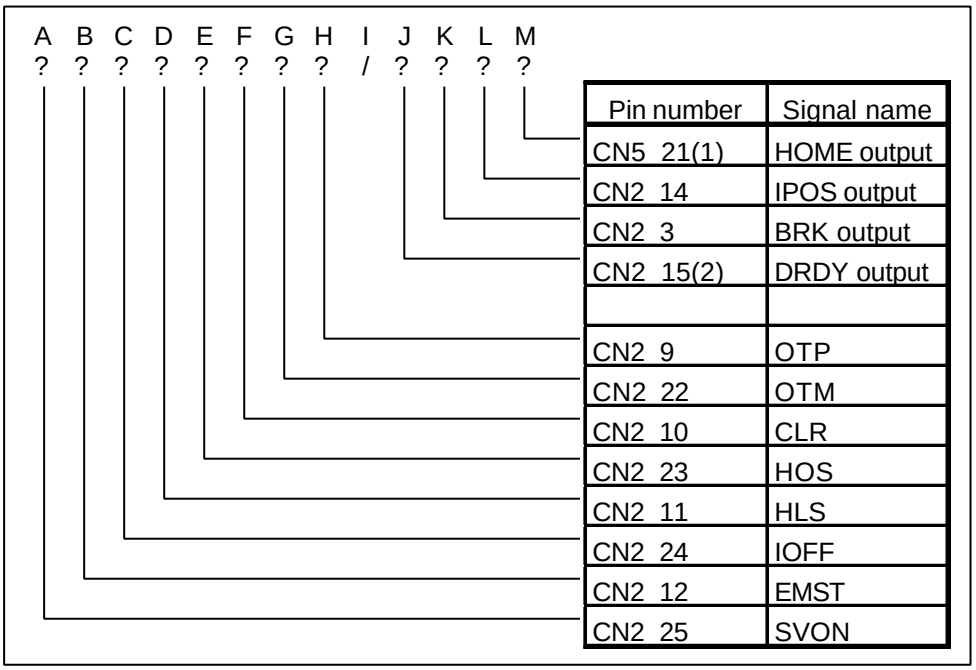
Appendix 1: Verify Input / Output Signal

IO: Status of Input / Output Signal

- IO command monitors status of CN2 and CN5 Input / Output signal.
- This command may be used for checking the wiring.
  - ◊ Input format

    IO0 / RP : Indication of I/O signal status.
    IO2 / RP : Indication of I/O related to programmed operation.
    IO3 / RP : Indication of I/O related to Jog operation.
    No / RP : Indicates only once.
    With / RP : Indicates in real time basis.

Figure A-1: Indication format (IO0 / RP: Indication of I/O signal status)

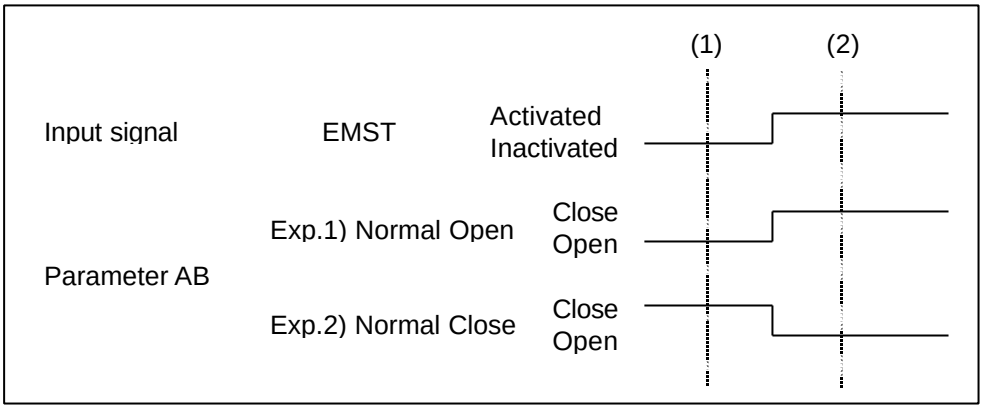


Pin number	Signal name
CN5 21(1)	HOME output
CN2 14	IPOS output
CN2 3	BRK output
CN2 15(2)	DRDY output
CN2 9	OTP
CN2 22	OTM
CN2 10	CLR
CN2 23	HOS
CN2 11	HLS
CN2 24	IOFF
CN2 12	EMST
CN2 25	SVON

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

IO0 command reports the state of circuit in regard to input signal.
IO1 command reports the state of execution of the function in regard to input signal.

Figure A-2



Exp.1) EMST input setting : Normal open (ABX0XXXXXX)

IO0 and IO1 report same state as shown in Table A-1 at the timing (1) and (2) in Figure A-2.

Table A-1

Timing	IO command	Report
(1)	IO0	ABCDEFGHIJK ∗0∗∗∗∗∗/∗∗∗∗
	IO1	ABCDEFGHIJK ∗0∗∗∗∗∗/∗∗∗∗
(2)	IO0	ABCDEFGHIJK ∗1∗∗∗∗∗/∗∗∗∗
	IO1	ABCDEFGHIJK ∗1∗∗∗∗∗/∗∗∗∗

Exp.2) EMST input setting : Normal close (ABX1XXXXXX)

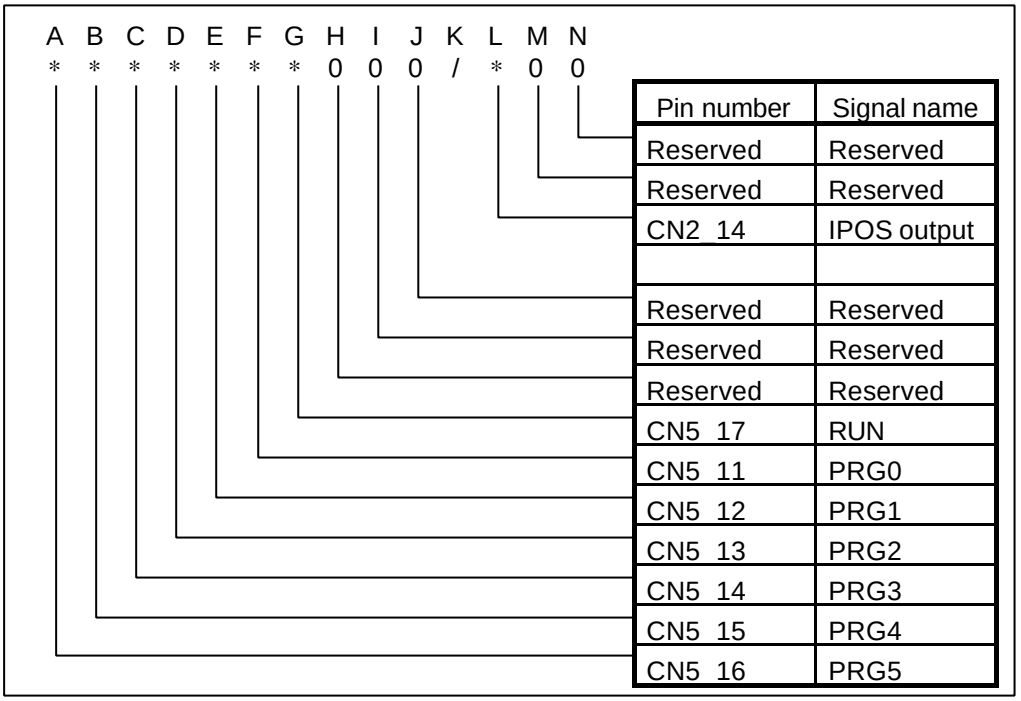
IO0 and IO1 report opposite state as shown in Table A-2 at the timing (1) and (2) in Figure A-2.

Table A-2

Timing	IO command	Report
(1)	IO0	ABCDEFGHIJK ∗0∗∗∗∗∗/∗∗∗∗
	IO1	ABCDEFGHIJK ∗1∗∗∗∗∗/∗∗∗∗
(2)	IO0	ABCDEFGHIJK ∗1∗∗∗∗∗/∗∗∗∗
	IO1	ABCDEFGHIJK ∗0∗∗∗∗∗/∗∗∗∗

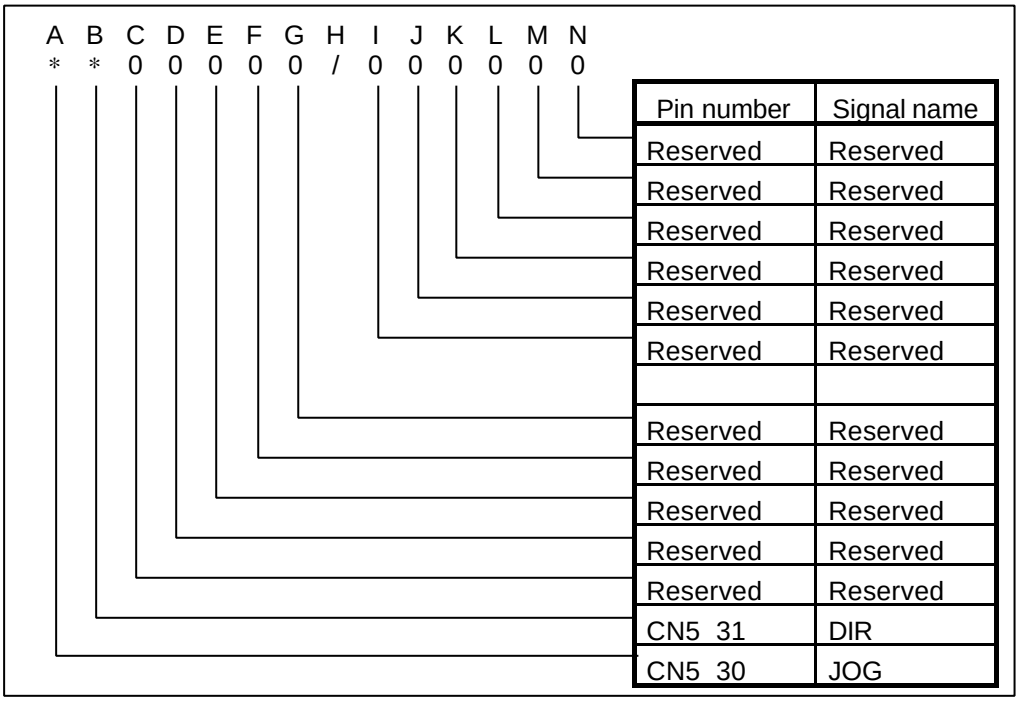
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Figure A-3: Indication format (IO2 / RP: Indication of I/O relate4d to programmed operation)



Pin number	Signal name
Reserved	Reserved
Reserved	Reserved
CN2 14	IPOS output
Reserved	Reserved
Reserved	Reserved
Reserved	Reserved
CN5 17	RUN
CN5 11	PRG0
CN5 12	PRG1
CN5 13	PRG2
CN5 14	PRG3
CN5 15	PRG4
CN5 16	PRG5

Figure A-4: Indication format (IO3 / RP: Indication of I/O related to Jog operation)



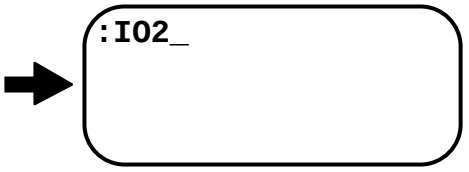
Pin number	Signal name
Reserved	Reserved
Reserved	Reserved
Reserved	Reserved
Reserved	Reserved
Reserved	Reserved
Reserved	Reserved
Reserved	Reserved
Reserved	Reserved
Reserved	Reserved
Reserved	Reserved
Reserved	Reserved
CN5 31	DIR
CN5 30	JOG

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

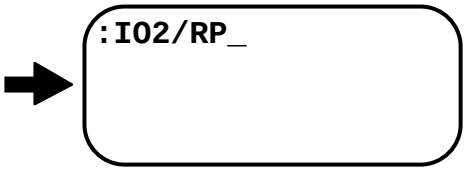
[Example] Verify the start command of channel program "RUN" is on.

1) Confirm that the display of Handy Terminal indicates the colon (:).
(If the display does not show the colon press [ENT] key once.)

2) [I] [O] [2 #]

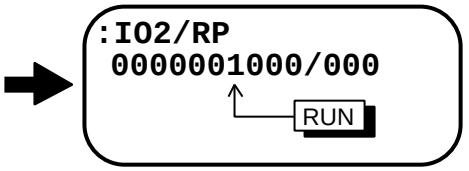


3) [/] [R] [P]



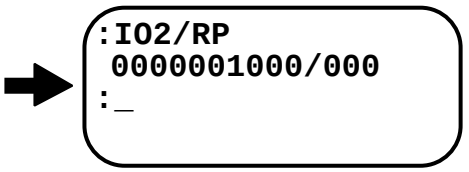
4) Press [ENT] key for execution. Indication starts immediately after the input.

[ENT]



5) Press [BS] key to discontinue the readout. Otherwise you cannot enter next command.

[BS]



[Discription]

- Above example shows that the readout of RUN input is "1," which indicates "RUN" input is on.
  - ◊ In case of the above example, the status of Input / Output signal are monitored and indicated until [BS] key is pressed.
  - ◊ On and Off of the Input / Output signals will be followed during the readout by changing in "1" to "0" or the other way.
  - ◊ However, if inputting / RP is omitted in procedure 3) in the above example, I/O status will be indicated only once just after [ENT] key is pressed.

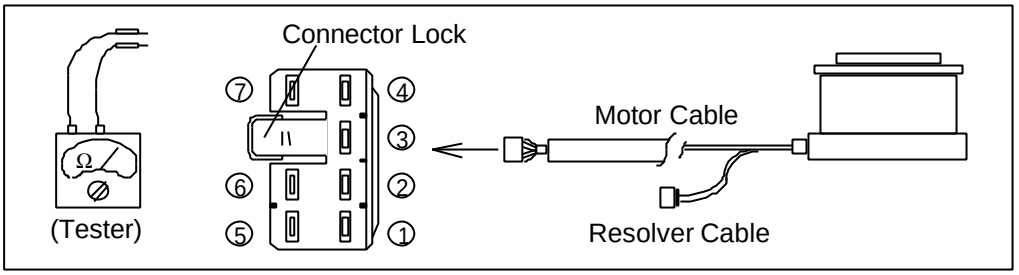
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Appendix 2 : How to Check Motor Condition

- Examine resistance and isolation of Motor windings to find out its condition.
- Firstly conduct the checks with the Cable Set. If the result does not meet the specification, check the Motor only.

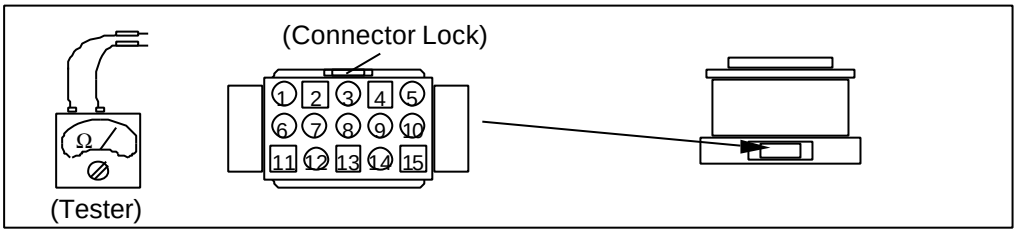
1 Resistance of Motor windings

Figure A-5: With Cable Set



- Refer to Table A-3 for pin numbers to be checked.

Figure A-6: Motor only



- Refer to Table A-3 for pin numbers to be checked.

Table A-3 : Pin number to be checked.

	Cable connector	Motor connector	Result
Phase A	① ↔ ② (A+) (A-)	⑤ ↔ ④ (A+) (A-)	
Phase B	③ ↔ ④ (B+) (B-)	⑩ ↔ ⑨ (B+) (B-)	
Phase C	⑤ ↔ ⑥ (C+) (C-)	⑮ ↔ ⑭ (C+) (C-)	

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

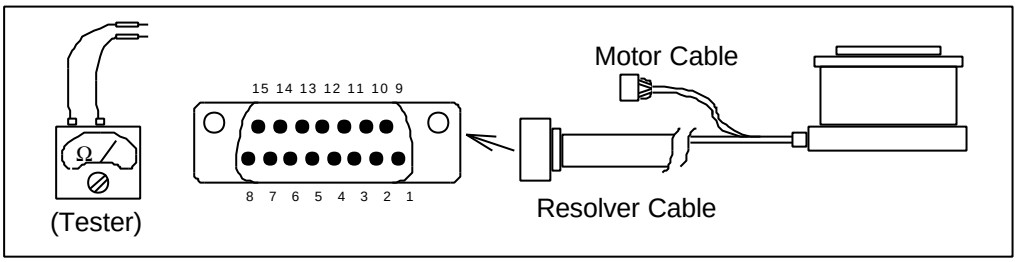
Table A-4: Specification of Motor resistance

Motor number	Motor winding resistance (Ω)	Specification
YS2005	35.0	1. Allowance : ±30%
YS2020	4.5	2. Variations between each phase : 1.0Ω or less
YS3008	47.0	(øA, øB, øC)
YS3040	6.4	
YS4080	5.2	
YS5120	3.5	
YS5240	6.4	
JS0002	9.6	
JS1003	15.4	
JS2006	9.2	
JS2014	14.6	

- For special Motor windings or long cable (over 4m), contact NSK for specification.

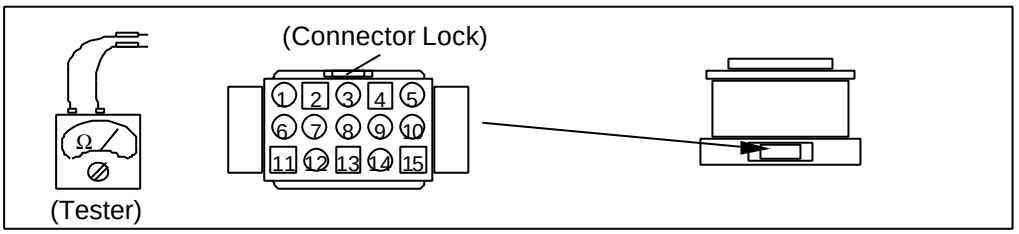
2 Resistance of resolver windings

Figure A-7: With cable set



- Refer to Table A-5 for pin numbers to be checked.

Figure A-8: Resolver only



- Refer to Table A-5 for pin numbers to be checked.

Table A-5: Pin number to be checked for incremental resolver

	Cable connector	Motor connector	Result
REA	⑧ ↔ ④ (REA) (COM)	① ↔ ② (REA) (COM)	
REB	⑦ ↔ ④ (REB) (COM)	⑥ ↔ ② (REB) (COM)	
REC	⑮ ↔ ④ (REC) (COM)	⑪ ↔ ② (REC) (COM)	

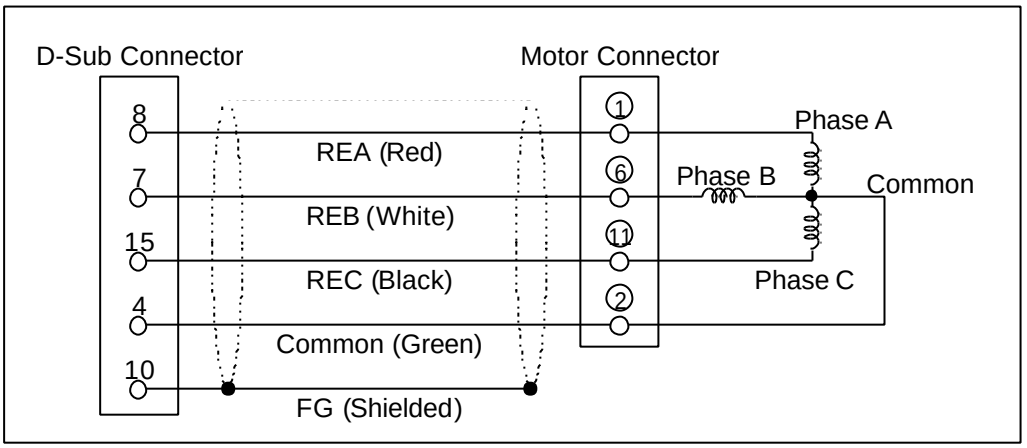
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Table A-6: Specifications of resolver resistance

Motor number	Motor winding resistance (Ω)	Specification
YS2005	3.8	1. Allowance : ±30% 2. Variations between each phase : 1.0Ω or less (øA, øB, øC)
YS2020	3.8	
YS3008	3.7	
YS3040	3.7	
YS4080	2.8	
YS5120	2.6	
YS5240	2.6	
JS0002	2.3	
JS1003	2.6	
JS2006	3.9	
JS2014	3.8	

- For special Motor windings or long cable (over 4m), contact NSK for specification.

Figure A-9: Resolver wiring (For your reference)



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3 Insulation resistance of Motor winding

Caution : Disconnect the Motor from the Driver Unit when checking insulation resistance of Motor winding.

Caution : Do not apply more than 500 DCV.

Figure A-10: With Cable Set

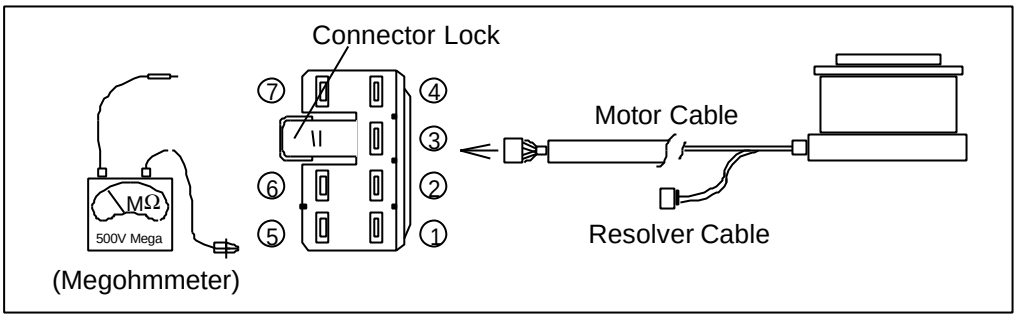


Figure A-11: Motor only

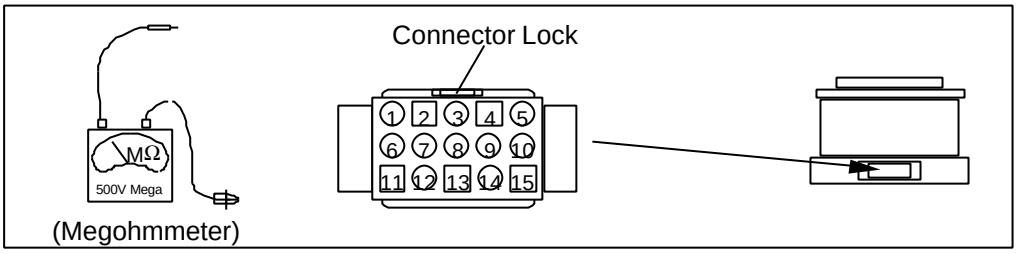


Table A-7: Pins to be checked

	Cable connector	Motor connector	
Phase A–FG	① ↔ ⑦ (A+) (FG)	⑤ ↔ ⑬ (A+) (FG)	
Phase B–FG	③ ↔ ⑦ (B+) (FG)	⑩ ↔ ⑬ (B+) (FG)	
Phase C–FG	⑤ ↔ ⑦ (C+) (FG)	⑮ ↔ ⑬ (C+) (FG)	
Phase A–B	① ↔ ③ (A+) (B+)	⑤ ↔ ⑩ (A+) (B+)	
Phase B–C	③ ↔ ⑤ (B+) (C+)	⑩ ↔ ⑮ (B+) (C+)	
Phase C–A	⑤ ↔ ① (C+) (A+)	⑮ ↔ ⑤ (C+) (A+)	

Table A-8: Specification (For all Motor series)

	Specification
With cable	1MΩ minimum
Motor only	2MΩ minimum

4 Motor and cables appearance check

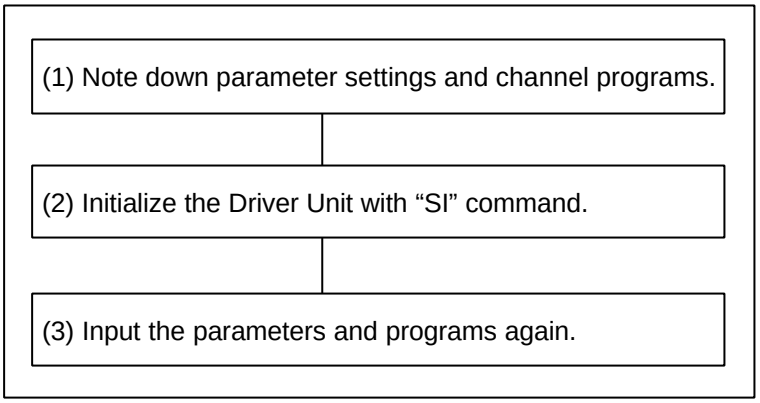
- Check for Motor damage.
- Check for cable insulation.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Appendix 3 : Initializing Driver Unit

- When troubleshooting or replacing a Motor or a Driver Unit, you may need to initialize the Driver Unit. In such a case, follow the procedures described hereunder.
- Initialization of the Driver Unit requires three steps as shown in Figure A-12.
- Use Handy Terminal FHT11 for inputting command.

Figure A-12


(1) Note down parameter settings and channel programs.
(2) Initialize the Driver Unit with “SI” command.
(3) Input the parameters and programs again.

Explanations

1 Read out parameter settings and channel programs and note down them. Especially “PA” and “RO” data are important for ESA Driver Unit for absolute position resolver.

1) Connect the Handy Terminal FHT11 to CN1 connector of Driver Unit and turn on the power.

↓

2) Monitor the parameters with “TS0” command.
Internal program may be monitored by “TC data” command.

↓

3) After monitoring, turn the power off.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

2 Initialize Driver Unit.

1) Connect the Handy Terminal FHT11 to CN1 connector of the Driver Unit.

↓

2) Turn on the control power only.

↓

3) Input the password. When the colon ":" is displayed,

Press [/] [N] [S] [K] [SP] [O] [N] [ENT].

↓

4) Driver Unit echoes back "NSK ON."

↓

5) Input "SI/SY" command.

Press [S] [I] [/] [S] [Y].

↓

6) Driver Unit echoes back "INITIALIZE." A colon ":" will be displayed to indicate completion of initializing.

3 Input the noted parameter settings and channel programs.

1) Firstly set "PA" parameter.

- Input the password.

Press [/] [N] [S] [K] [SP] [O] [N] [ENT].

Driver Unit echoes back "NSK ON."

↓

2) Press [P] [A] [*] [*] [ENT]

(** must be the same data as noted.)

↓

3) Set other parameters and programs accordingly.

↓

4) Make sure that all parameters and programs are set properly.

↓

Monitor the settings with "TS0" and "TC data" commands.

↓

5) Turn off the power.

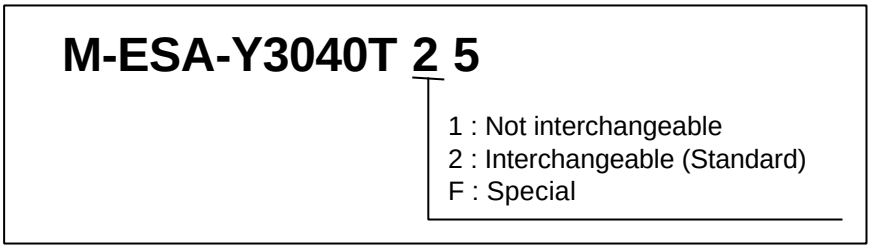
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Appendix 4 : How to Replace ESA25 Driver Unit

Danger : Make sure the power is turned off when replacing ESA25 Driver Unit.

- In the reference number of ESA25 Driver Unit, second digit from the last denotes whether it is interchangeable or not.

Figure A-13



- For interchangeable (standard) Driver Unit, replace with the Driver Unit which has the same reference number. Set the same parameters to new Driver Unit.

- When replacing Driver Unit which is not interchangeable, the compensation ROM of the old Driver Unit must be transferred to the new Driver Unit. When transferring the ROM, the Driver Unit must be disassembled. To disassemble Driver Unit, follow the procedures described hereafter.

  ◊ For a special Driver Unit, contact your local NSK representative.

  ◊ Before replacing the Driver Unit, record all parameters and channel programs. The record list is provided in the last page of this manual.

  ◊ Especially, following items shall be recorded.

    • PA, VG, VI, PG, CO, MA, MV, and HO

    • Programs and other settings in channels.

  ◊ When replacing Driver Unit, following tools and Handy Terminal FHT11 are necessary.

    1) A screwdriver (cross recessed, 4mm)

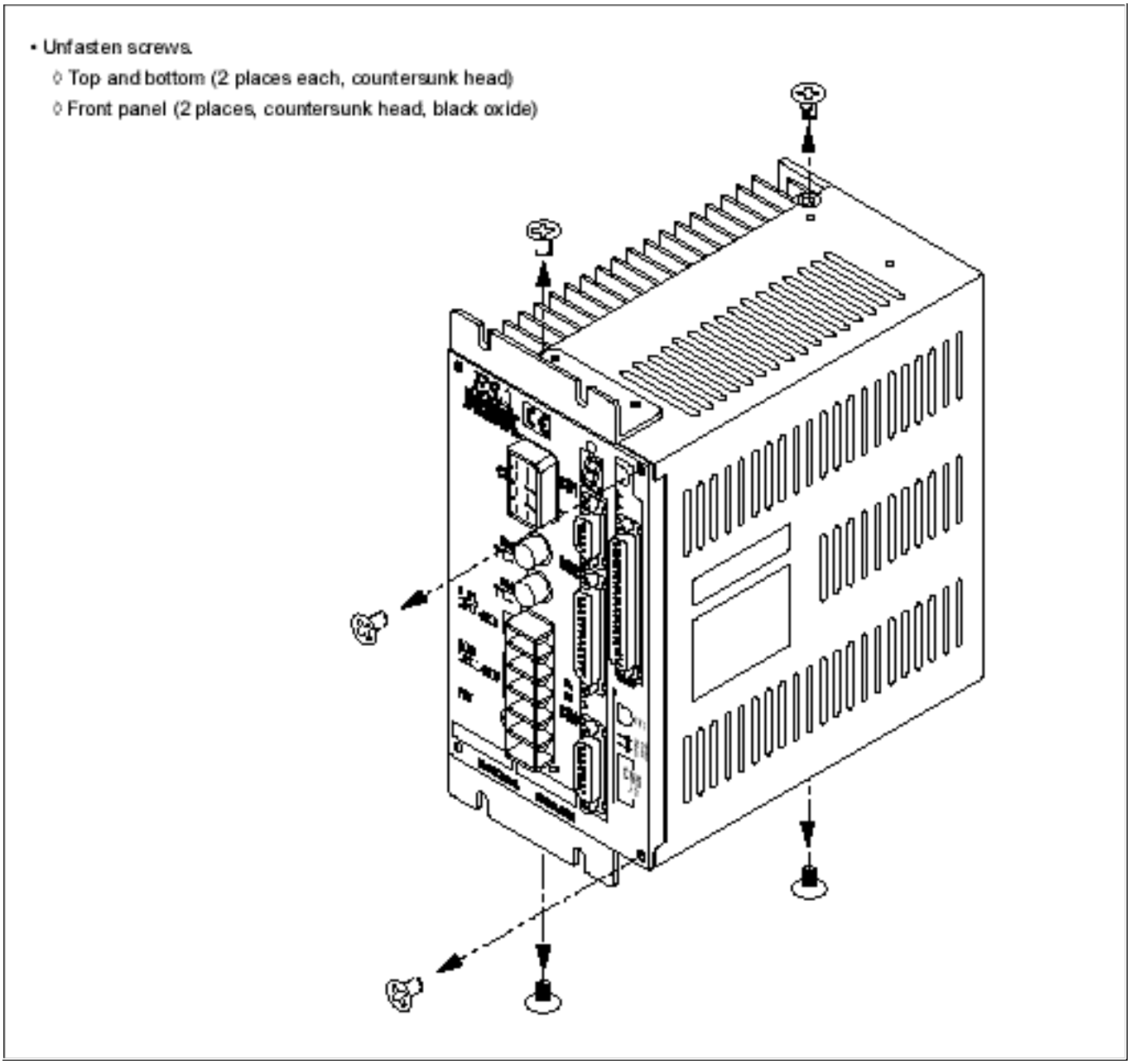
    2) A ROM remover

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Dissemble ESA25 Driver Unit

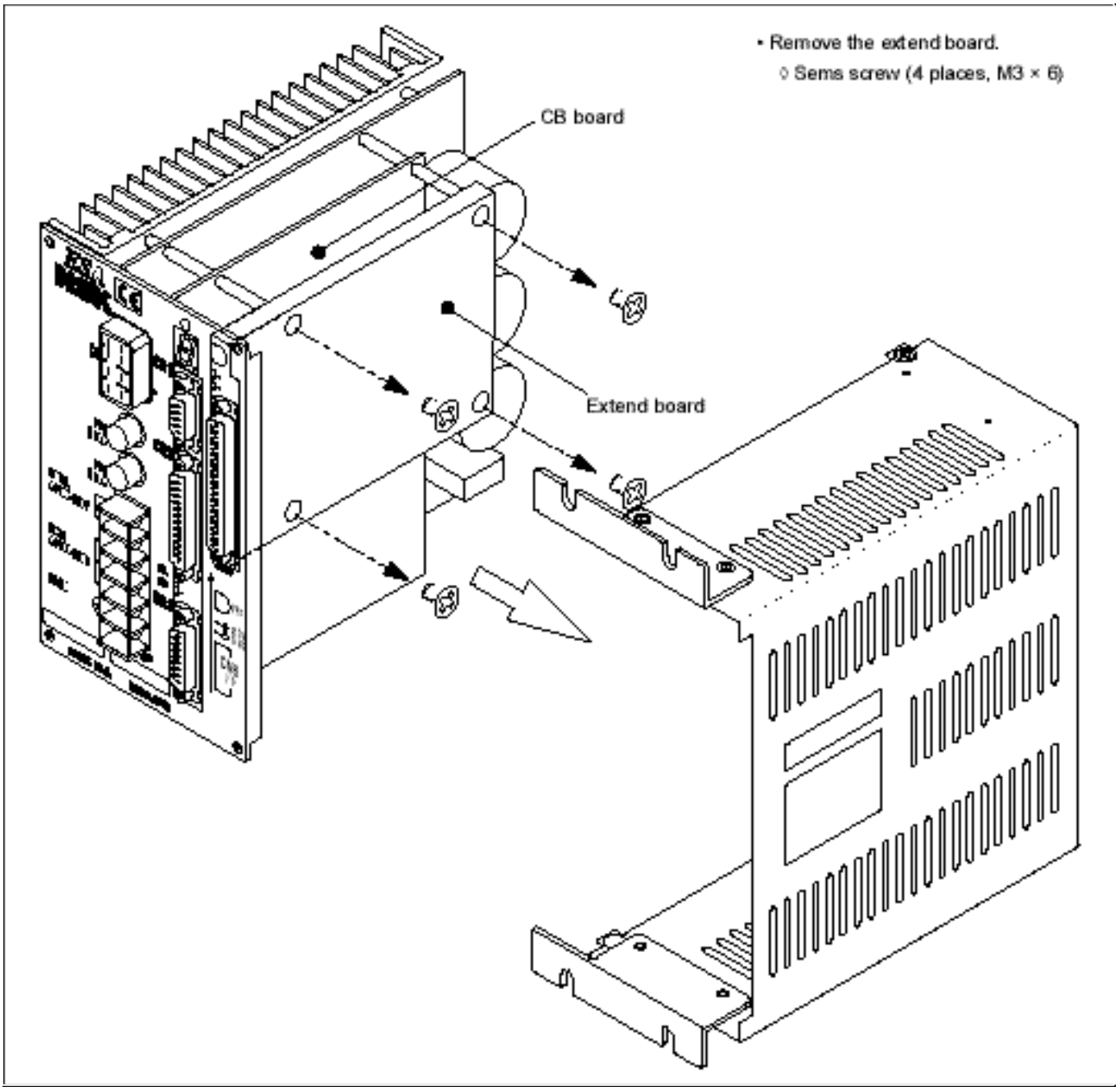
1 Remove side panel.

Figure A-14



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Figure A-15



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

2 Remove the compensation ROM (U101) from CB board of old Driver Unit. (Use a ROM remover.)

Figure A-16

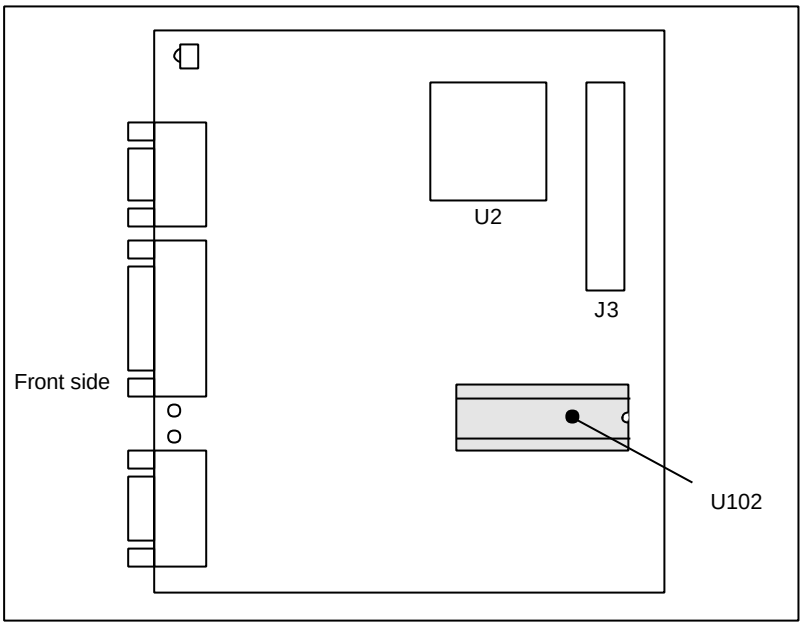
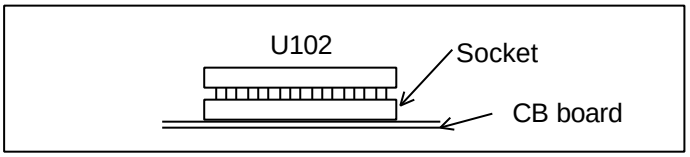


Figure A-17



3 Insert the ROM to new Driver Unit commutation board.

- Be careful of the orientation of the ROM. Make sure the ROM is securely set to the socket.

Caution : When the version of two Driver Units are different, take a special care as the orientation of IC differs in Version 11 and 21.

Figure A-18

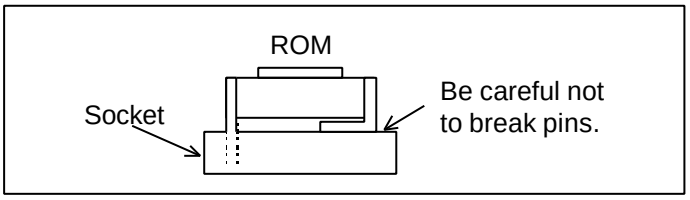
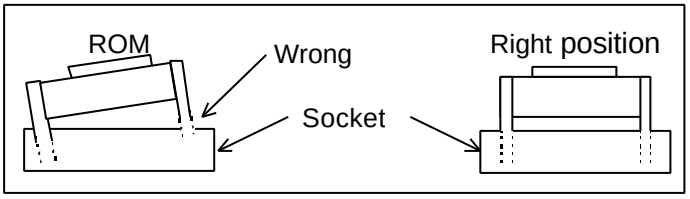


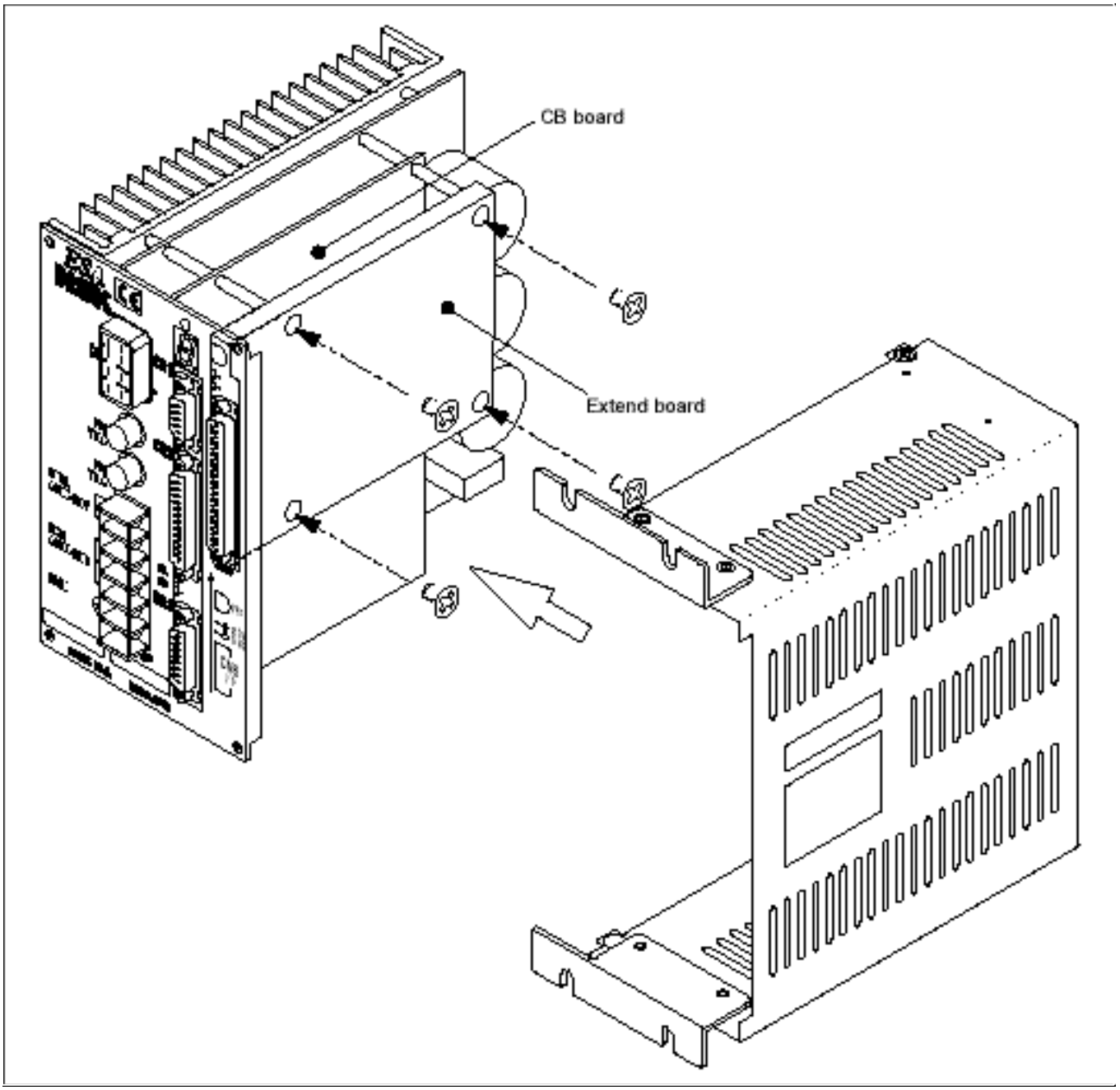
Figure A-19



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

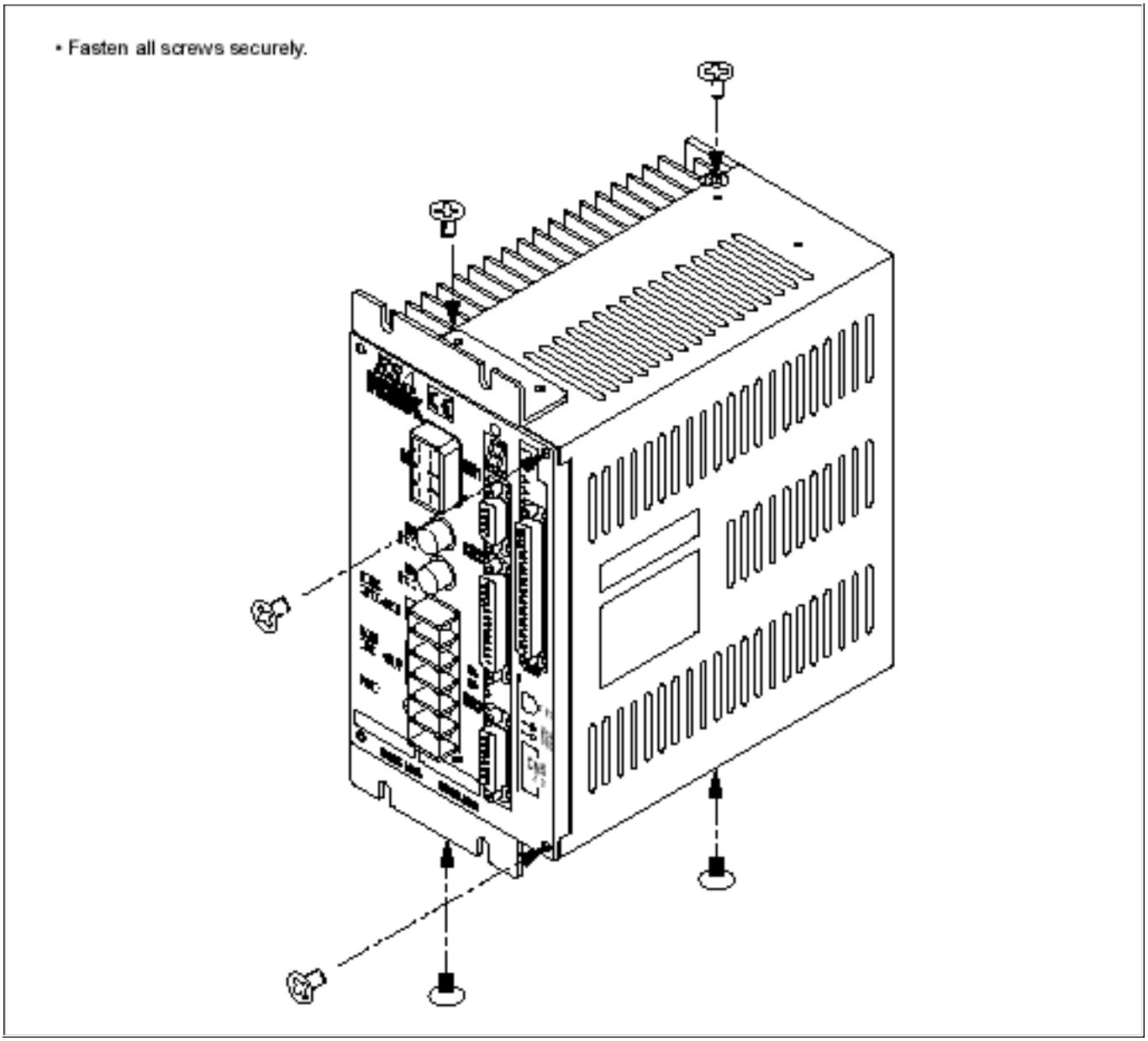
4 Assemble the extend board removed from old Driver Unit to the new Driver Unit.

Figure A-20



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Figure A-21



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

5 After replacing the compensation ROM, initialize new Driver Unit.

1) Connect Handy Terminal FHT11 to CN1 connector.

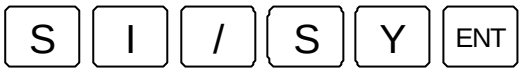
2) Turn on the control power only.
(Control power input ports are indicated as “CONT” on the terminal block.)

   ◊ If the main and control power cannot be turned on and off separately, disconnect CN2 connector. If CN2 connector is not disconnected, the parameters cannot be input properly and the Motor may run away. (Make sure that CN2 connector is disconnected.)

3) When control power is turned on, Handy Terminal displays “NSK MEGATORQUE···”.

   ◊ After the display shows a colon “:”, input

   and

   Initialization will take about 30 seconds.

4) After the display shows a colon “:”, log in all parameters and channel program referring the recorded data and settings.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Appendix 5 : Regeneration Dump Resistor

- Megatorque Motor will function as a generator in the following conditions. This phenomenon is called regeneration.
    - ◊ When decelerating under heavy inertia.
    - ◊ When the Motor axis is horizontal, weight of an unbalanced load attached to the rotor gives torque load to the Motor.
- Energy generated by the motor will be charged to the main power circuit condenser. If energy is more than the capacity of the condenser, a dump resistor of the Driver Unit will dissipate overflown energy.
- However, when the regeneration occurs frequently, the dump register will be overheated due to its limited capacity. Eventually over-heat alarm will be on and Motor will stop.

    * Dump resistor capacity is about 2.5W.

- When an over-heat alarm is detected, following remedies should be taken.
    - ◊ Reduce duty cycle
    - ◊ Decrease acceleration/deceleration.
    - ◊ Lower operation speed.
- If above measures are not feasible, an optional high capacity regenerative dump register is available from NSK. It will dissipate regeneration energy without loosing speed of Megatorque Motor.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Appendix 6: Brake Built in YS Series Motor

1. Specifications

Table A-9

Motor type	Brake type	Staic friction torque (N·m)	Capacity (W)	Coil resistance (Ω)
YS2020	RNB2K	20	17	477
YS3040	RNB4K	40	23	352
YS4080	RNB8K	80	30	270
YS5120	RNB12K	120	33	245

Rated voltage : DC90V
Insulation class : B grade
Overexertion : DC180V, 0.35 sec
Friction material : None-asbestos

- The RNB brake comprises 12 parts as shown in Figures A-32 ~A-35.
- The armature assembly (③) is fixed with bolts (⑤) and (⑩) through the plate spring (④) in the field (①) incorporating the excitation coil.
- The armature assembly is supported with the plate spring, and is separated from the field by a narrow gap. Loaded with the coil spring (②) built in the field, the assembly presses the disk (⑦) to apply brake.
- When the coil is turned on, the field attracts the assembly against the coil spring pressure, thereby removing the pressure on the disk and releasing the brake.
- When the power supply is turned off, the coil spring force presses the armature assembly against the disk, quickly applying the brake.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Figure A-24: RNB2K

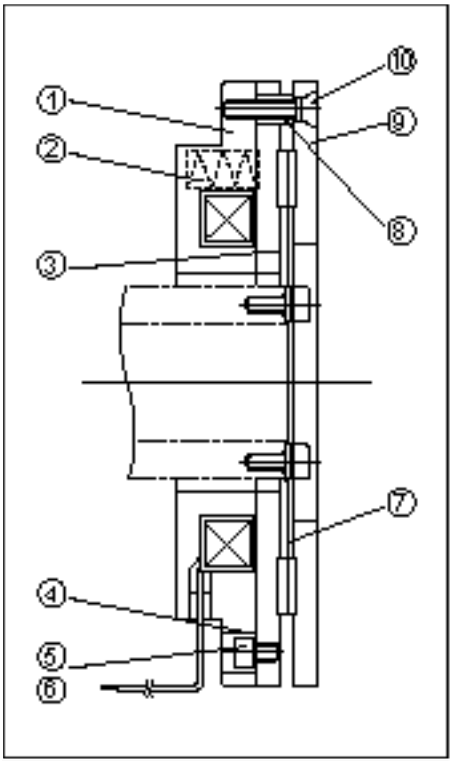


Figure A-25: RNB4K

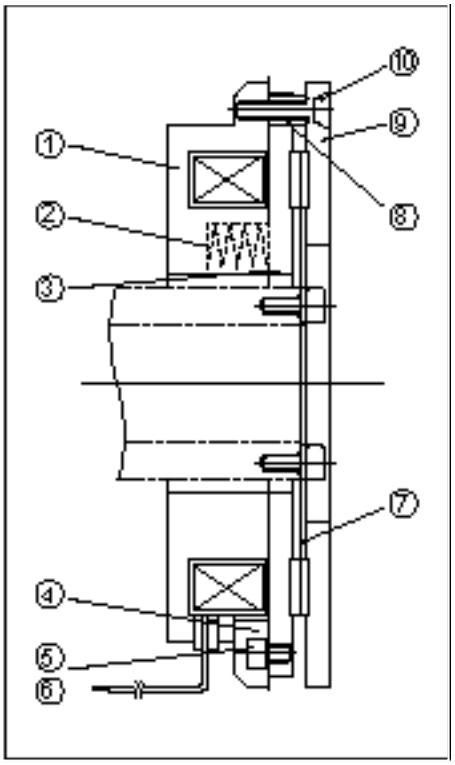


Figure A-26: RNB8K

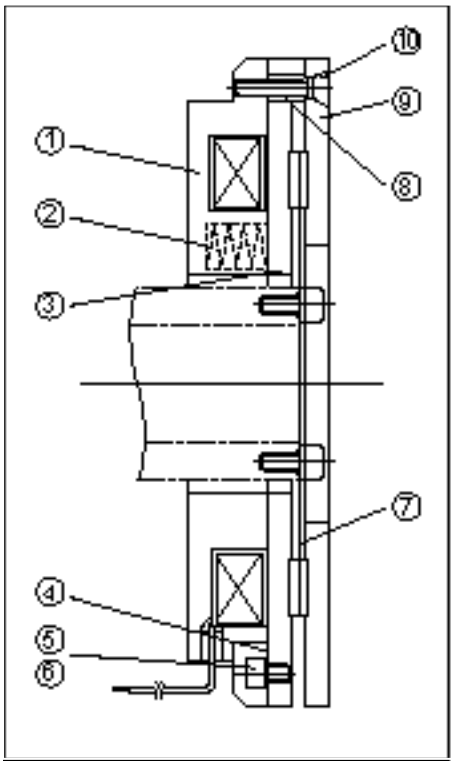
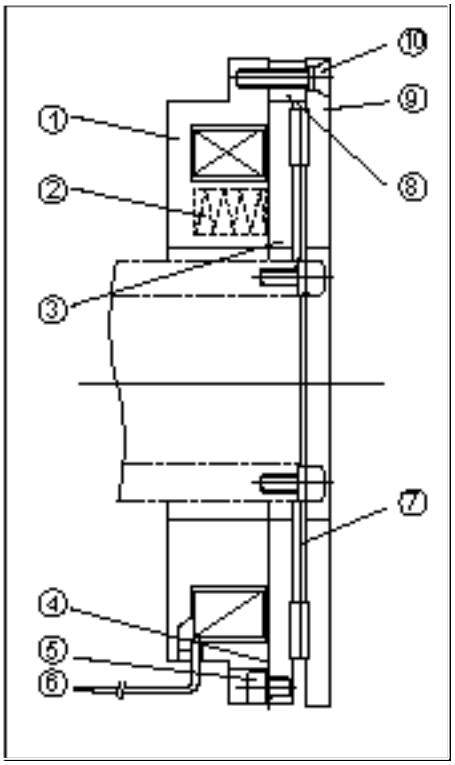


Figure A-27: RNB12K



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Table A-10: Parts list

Number	Name	RNB 2K	RNB 4K	RNB 8K	RNB 12K
①	Field	1	1	1	1
②	Coil spring	9	6	8	8
③	Armature assembly	1	1	1	1
④	Plate spring	1	1	1	1
⑤	Bolt	Hex. socket cap bolt 3			
⑥	Safety spring washer	3	3	3	3
⑦	Disk	1	1	1	1
⑧	Collar	3	3	6	6
⑨	Side plate assembly	1	1	1	1
⑩	Hex. socket coutersunk head screw	3	3	6	6

3. Handling precautions

1) This brake is dry type. Its torque will decrease when the friction surface is soiled with oil. Use care never to allow oil to enter it.

2) The electromagnetic brake uses many mild materials. Use care not to hit or drop the brake, or apply excessive force to it, otherwise indented or deformed brake could malfunction or have insufficient torque.

4. Manual Release of Brake

- Insert manual brake releasing bolts to 3 tap holes of the side plate, then screw them alternatively to press the armature assembly to the field side to release the brake.
- Use a care to screw the bolts alternatively to push the armature assembly evenly.

Table A-11

Type	RNB2K	RNB4K	TNB8K	RNB12K
Manual release bolt	M5	M5	M6	M6

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

5. Troubleshooting

- When the brake does not perform as intended, check followings.

◆ Brake is slipping.

1) Is the friction plate soiled with oil?

2) Is temperature of the brake too high? (over 100 ℃)

3) Is excessive load applied to the machine?

◆ Sluggish operation of the brake

1) Is sufficient voltage being supplied?

2) Is the friction plate worn out ? (too much gap)

3) Is brake temperature too high? (over 100 ℃)

◆ The brake does not operate entirely.

1) Breakage of coil and/or lead wire

2) Electrical circuit failure

3) Too much gap of the friction plate because of wear?

4) Is sufficient voltage being supplied?

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Appendix 7: Parameter • Program Setting List (ESA25 standard Driver Unit)

Reference No. :
S/N :

Parameter

• Blank settings are factory set. Data :

Parameter	Setting		Parameter	Setting		Parameter	Setting	
	Shipping set	Current setting		Shipping set	Current setting		Shipping set	Current setting
PG	0.1		CR	X1		RC	*	
VG	1.0		PC	0		LR	0	
VI	1.0		RR	-1		AB	X0X0XX00	
VM	1		FD	0		NW	2	
LG	50		FZ	0		MM	1	
TL	100		FR	0		BM	1	
FO	0		PS	1		CM	0	
FP	0		DI	0		AN	0	
FS	0		OTP	0		WM	0	
NP	0		OTM	0		SE	0	
NS	0		MV	1		LO	0	
DBP	0		MA	1		SG	0	
DBA	0		JV	0.1		MT	*	
ILV	100		JA	1		RI	*	
FF	0		HV	0.2		ZP	1.00	
FC	0		HA	1		ZV	1.4	
CO	50 000		HZ	0.0100		SL	3	
IN	100		OS	4		AC	1	
IS	0		HD	1		AGV	1	
FW	1		HO	0		AGT	1	
VO	1 365		PA	(700) **				
VW	100		OL	*				

* Differs with size of Motor.

** Differs with each Motor in case of non-interchangeable models.

● Notice for resetting or copying parameters.

◊ You do not need to set LO and SG parameters as they are for adjusting PG, VG, VI and MA automatically.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Reference No. :
S/N :

Channel Program

- A blank part is not programmed.

Data :

CH	Program	CH	Program	CH	Program	CH	Program
0	Command : CV : CA :	16	Command : CV : CA :	32	Command : CV : CA :	48	Command : CV : CA :
1	Command : CV : CA :	17	Command : CV : CA :	33	Command : CV : CA :	49	Command : CV : CA :
2	Command : CV : CA :	18	Command : CV : CA :	34	Command : CV : CA :	50	Command : CV : CA :
3	Command : CV : CA :	19	Command : CV : CA :	35	Command : CV : CA :	51	Command : CV : CA :
4	Command : CV : CA :	20	Command : CV : CA :	36	Command : CV : CA :	52	Command : CV : CA :
5	Command : CV : CA :	21	Command : CV : CA :	37	Command : CV : CA :	53	Command : CV : CA :
6	Command : CV : CA :	22	Command : CV : CA :	38	Command : CV : CA :	54	Command : CV : CA :
7	Command : CV : CA :	23	Command : CV : CA :	39	Command : CV : CA :	55	Command : CV : CA :
8	Command : CV : CA :	24	Command : CV : CA :	40	Command : CV : CA :	56	Command : CV : CA :
9	Command : CV : CA :	25	Command : CV : CA :	41	Command : CV : CA :	57	Command : CV : CA :
10	Command : CV : CA :	26	Command : CV : CA :	42	Command : CV : CA :	58	Command : CV : CA :
11	Command : CV : CA :	27	Command : CV : CA :	43	Command : CV : CA :	59	Command : CV : CA :
12	Command : CV : CA :	28	Command : CV : CA :	44	Command : CV : CA :	60	Command : CV : CA :
13	Command : CV : CA :	29	Command : CV : CA :	45	Command : CV : CA :	61	Command : CV : CA :
14	Command : CV : CA :	30	Command : CV : CA :	46	Command : CV : CA :	62	Command : CV : CA :
15	Command : CV : CA :	31	Command : CV : CA :	47	Command : CV : CA :	63	Command : CV : CA :

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

World-wide Manufacturing and Marketing Organization

NSK Ltd. INTERNATIONAL DIVISION
JAPAN: Tokyo Phone: 03-3779-7120

NSK CORPORATION
U.S.A.: Ann Arbor Phone: 313-761-9500

[Precision Products Business Unit]
U.S.A. : Chicago Phone: 630-924-8000
: Los Angeles Phone: 562-926-3578
: Ann Arbor Phone: 761-761-9500

NSK CANADA INC.
CANADA : Toront Phone: 905-890-0740
: Montreal Phone: 514-633-1240
: Vancouver Phone: 800-663-5445

NSK RODAMIENTOS MEXICANA, S.A. DE C.V.
MEXICO: Mexico City Phone: 5-301-2741,5-301-3115

NSK DO BRASIL INDUSTRIA E COMÉRCIO DE ROLAMENTOS LTDA.
BRASIL : São Paulo Phone: 001-269-4700
: Porto Alegre Phone: 051-222-1324
: Belo Horizonte Phone: 031-224-2508

NSK UK LTD
ENGLAND : Ruddington Phone: 0115-936-6600

NSK DEUTSCHLAND G.m.b.H
GERMANY : Düsseldorf Phone: 02102-4810
: Stuttgart Phone: 0711-79082-0
: Leipzig Phone: 0341-5631241

NSK FRANCE S.A.
FRANCE : Paris Phone:1.30.57.39.39
: Lyon Phone: 72.15.29.00

NSK NETHERLANDS B.V.
NETHERLAND: Amsterdam Phone: 020-6470711

NSK ITALIA S.p.A.
ITALIA: Milano Phone: 02-995191

NSK IBERICA, S.A.
SPAIN: Barcelona Phone: 93-575-1662

NSK AUSTRALIA PTY, LTD.
AUSTRALIA : Melbourne Phone: 03-9764-8302
: Sydney Phone: 02-9893-8322
: Brisbane Phone: 07-3393-1388
: Adelaide Phone: 08-8373-4811
: Perth Phone: 089-434-1311

NSK BEARINGS NEW ZEALAND LTD.
NEW ZEALAND: Auckland Phone: 09-276-4992

NSK KOREA CO., LTD.
KOREA: Seoul Phone: 02-3287-6001

NSK SINGAPORE (PRIVATE) LTD.
SINGAPORE: Singapore Phone: 2781711

NSK BEARINGS (THAILAND) CO., LTD.
THAILAND : Bangkok Phone: 2-6412150-60
: Chiang mai Phone: 053-246993~4

TAIWAN NSK PRECISION CO., LTD.
TAIWAN: Taipei Phone: 02-591-0656

MEGATORQUE® MOTOR SYSTEM

User's Manual

(ESA25 Driver Unit System)

Document Number: C20062-06 EC-T

October 20, 1997	1st Edition
August 24, 1999	2nd Edition
September 28, 1999	3rd Edition
December 2, 1999	4th Edition
January 31, 2000	5th Edition
April 27, 2001	6th Edition 1st Printing

NSK Ltd.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

NSK

6th Edition, 1st Printing April 27, 2001 Document Number: C20062-06

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Artisan Technology Group

Artisan Technology Group is your source for quality new and certified-used/pre-owned equipment

- FAST SHIPPING AND DELIVERY
- TENS OF THOUSANDS OF IN-STOCK ITEMS
- EQUIPMENT DEMOS
- HUNDREDS OF MANUFACTURERS SUPPORTED
- LEASING/MONTHLY RENTALS
- ITAR CERTIFIED SECURE ASSET SOLUTIONS

SERVICE CENTER REPAIRS
Experienced engineers and technicians on staff at our full-service, in-house repair center

WE BUY USED EQUIPMENT
Sell your excess, underutilized, and idle used equipment
We also offer credit for buy-backs and trade-ins
www.artisantg.com/WeBuyEquipment ↗

InstraView™ **REMOTE INSPECTION**
Remotely inspect equipment before purchasing with our interactive website at ***www.instraview.com*** ↗

LOOKING FOR MORE INFORMATION?
Visit us on the web at ***www.artisantg.com*** ↗ for more information on price quotations, drivers, technical specifications, manuals, and documentation

Contact us: (888) 88-SOURCE | sales@artisantg.com | www.artisantg.com